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CANADIAN PACIFIC RAILWAY.

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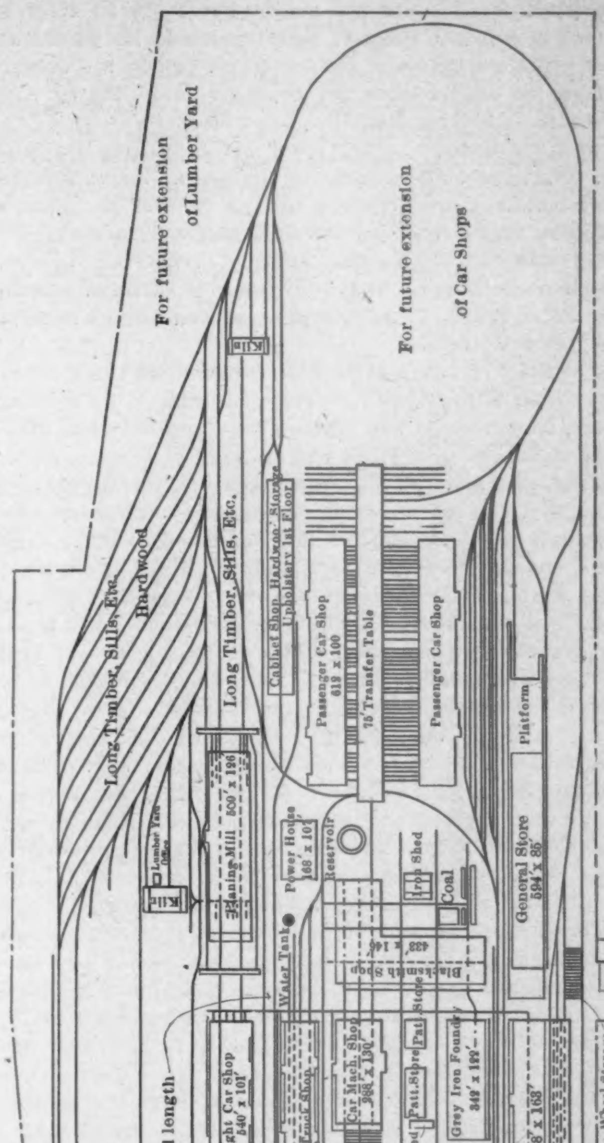
GENERAL ARRANGEMENT.

This is the largest railroad shop plant ever built and put into service at one time. It is interesting, because it involved a problem of combining construction as well as repairs of a large number of locomotives and cars, and the broad-minded and liberal plan of the works is exceedingly creditable to the road and to the engineers in charge. The plan and the construction should be carefully studied by those who have to do with the construction or operation of railroad shops. It is an engineer's plant on a magnificent scale, combining an excellent arrangement of well-constructed buildings, liberal provision for 100 per cent. extension of every building and unprecedented facilities for the storage and movement of material. There is no more interesting and instructive shop installation on the American continent.

Angus shops, situated within the city limits of Montreal, will provide for the maintenance of about 500 locomotives for the Eastern lines, the heavy repairs of from 5 to 10 per month may easily be increased to maintain 700 locomotives and build 100 new ones per year. The gray iron foundry has a capacity of 75 tons and the car wheel foundry 300 chilled cast-iron wheels per day. These and new shops nearly completed at Winnipeg, Manitoba, of about one-third of this capacity, will



ANGUS LOCOMOTIVE AND CAR SHOPS, MONTREAL—CANADIAN PACIFIC RAILWAY.

H. H. VAUGHAN, *Superintendent of Motive Power.* HENRY GOLDMARK, *Engineer of Shop Construction.*

for the Western lines, the building of 50 new locomotives per year, the construction of about 30 freight cars per day, and of 100 passenger equipment cars per year. The capacity put this road in an excellent position with respect to shop facilities.

The plant tract covers 200 acres. There are 20 acres of roofs and 28 miles of standard gauge tracks in the yards. Of these 6 miles are inside of the buildings. There are over 20 buildings, the largest being the locomotive shop, 162 by 1,166 ft., with the other buildings in proportion.

A 75-ft. "midway," served by a 10-ton electric traveling crane, forms the main channel of the plant. About this the various buildings are arranged with a view of the relative importance of the transportation of material to each, considering both the volume and weight. In general, the locomotive material goes south and car material north, or directly across the midway. There should be no doubling of material on its previous tracks.

The locomotive group is at the south end of the midway. At one corner is the locomotive shop, comprising the erecting, machine, tender, boiler and smaller departments in one building, the arrangement of which will be carefully presented later. This shop takes material from the storehouse, blacksmith shop and foundry. It has all other contributing departments under its own roof. Opposite is the storehouse, built in three sections, one for locomotive parts and supplies at the midway end, the center is for general stores for all parts of the line and the east end provides for the car shops and other stores which are easily transported. Next to the locomotive shop is the gray iron foundry, with its out-of-door, overhead traveling crane delivering material from the stock piles to the charging platform on one end and finished castings to the midway crane on the other. This building was placed close to the locomotive shop, because of the weight of the castings going to that department. Opposite the gray iron foundry is the blacksmith shop, with two wings in L shape, in order to separate the locomotive and car department deliveries without making the building too long. This shop is admirably located to deliver a large amount of car material to the truck and car machine shops opposite and to the locomotive shop. The pattern shop and fireproof pattern storage are near the foundry. The car machine shop is located with reference to the car wing of the blacksmith shop, and it is also near the foundry. The truck shop takes material from the car machine and blacksmith shops, and passes it on in the form of finished trucks to the freight car shop. While the passenger car shops take material from the car machine shops, it is not in sufficient volume to necessitate a nearer location. To build 30 freight cars per day material must be received in volume from its sources of supply, mainly the truck shop and planing mill. Because of the volume of wheel movement the wheel foundry was placed back of the truck shop, and far enough away for a large storage capacity for finished wheels. These pass through the truck shop, coming out in the finished trucks on the midway.

As the freight car shop is an assembling plant for large volumes of material; it was given most careful attention in order to secure delivery in as direct lines as possible. Finished lumber passes directly across the midway from the planing mill, with room for storage between the mill and the midway. A small transfer table facilitates the delivery. This space may be roofed over later, because of the heavy snowfall at this latitude. Straight-line movement is further conserved from the lumber storage to the mill, and the mill was made easily accessible from the passenger car shops. Because of the relatively smaller volume of material going into passenger cars, this movement does not need to be as direct and short as in the case of the freight car shop. Long material for passenger cars backs out of the mill for transfer over the connecting tracks, while short material comes from the side of the mill, near the west end, thus following straight lines through the machines of the mill.

With most of the power distribution on an alternating current basis, the power house was not placed at the center of the plant. It was more important to put it near the mill and cabinet shop, because about 18 tons of coal per day are saved by the use of shavings from these buildings. The shavings exhaust system is the most complete ever put into a railroad shop plant, for which credit is due the Sturtevant people as well as the engineers of the road. Aside from the use of the shavings, the mill requires more power than any department except the locomotive shop, which added a reason for this location of the power house.

Whereas freight car construction divides into about 90 per cent. of material to 10 per cent. of labor, that of passenger cars is in reverse proportion. A car remains but one day in the former and perhaps three months in the latter, if it is a sleeper or a diner. These facts led to the location of the passenger car shops in positions of general convenience. Two long shops, with a transfer table between them, provide for all the passenger car work except that done in the cabinet shop, which, by the way, is the only building about the plant which is evidently too small. Space between the transfer table and the shops on either side provides for the storage of trucks on the north side and for passenger cars outside the building on the south side. Light repairs may be made to coaches on these tracks. A yard for the storage of coaches is located south of the passenger car shops.

A shop for making frogs, switches and switch stands for the entire road is independently located west of the midway. This building receives some material from the blacksmith shop, but not in large volume.

The buildings were concentrated where they were wanted with reference to each other in a track plan which combines longitudinal and transverse tracks, the midway serving as a long transfer table, with tracks on the ground as well as a 10-ton overhead crane. This is very nicely worked out. A system of scrap bins, sheds and racks completes the plan. The open scrap bins are on an elevated platform, with the shears and scales housed in the center. It is likely that the bins will be roofed over later. This department is provided for the sale of scrap material exclusively.

A novel arrangement of platform scales will be put in later. This consists of a 60-ton scale 15 ft. long and a 100-ton scale 60 ft. long on the same track, with a space of one foot between them. On these scales the heaviest locomotive or the longest car may be weighed.

The construction of the shops began about two years ago, and they were put into service last August with the principal departments turning out a normal output from the first.

The plans and construction were carried out under the direction of Mr. E. H. McHenry, formerly chief engineer of the road, and Mr. Henry Goldmark, engineer of shop construction. Mr. Max Toltz served as consulting engineer for the equipment, and Mr. G. B. Mitchell as resident engineer of construction and installation.

The next article will show features of the buildings.

GAS ENGINE REGULATION.

In conclusion, the points brought out in this paper may be summed up somewhat as follows: Regulation of angular velocity through any one complete cycle of operations can be adjusted in gas engines to as small limits with as great certainty as in steam engines, but the problem requires possibly a more experienced man and greater care in application for it involves more variables. The results, however, can be made as good as for steam if not better. Regulation of speed, or constancy of revolutions per minute, is a thing which calls for a method of governing first and afterwards the application of well known principles already developed for steam work. The actual design of the governor mechanism to produce effects on mean effort quickly and certainly is not an easy thing, and there is a wide field here for both the inventor and the designer which the author feels is not yet filled—*Dr. C. E. Lucke, before New York Railroad Club.*

ECONOMICAL TRAIN OPERATION.

BY G. R. HENDERSON.

PART III.

(COST OF OPERATION CONTINUED.)

We have so far examined the effect of a continual rise and also the crossing of a summit but in many parts of the country we have simply an undulating profile. Let us now consider a division 150 miles long as before, with both terminals at the same elevation and the track an average level, except in three places, where we will suppose that there are up and down grades ten miles long each, the incline in all cases being 26 ft. per mile, or one-half of 1 per cent. We shall therefore have, in a trip over the division, 30 miles of up grade, 30 miles of down grade, and 90 miles of approximately level track. It is probable that on this section a lighter locomotive will be in use, somewhat as per the following specification:

TEN-WHEEL LOCOMOTIVE.

Theoretical tractive force...	37,500 lbs.
Available tractive force.....	30,000 lbs.
Diameter of drivers............	68 ins.
Area of grate................	37 sq. ft.
Weight of engine and tender..	130 tons

This will necessitate constructing a new diagram for determining the coal burned at various speeds and with different loads. This has been done in Fig. 2. The maximum rate per hour will be 37 × 200 = say 7,500 lbs. of coal per hour. The dotted lines show the consumption per mile, as before. The rising grades being so short, there will be no good object attained by loading the engine so that a high speed can be maintained on these portions, as all the speed desired can be made on the down grades and the levels. At 5 miles an hour, the gross load on these grades would be $\frac{30,000}{10+5}$ = 2,000 tons, and at 10 miles an hour $\frac{30,000}{10+5\frac{1}{2}}$ = 1,950 tons, or the net loading back of tender would be 2,000 — 130 = 1,870 tons, and 1,950—130 = 1,820 tons. In Fig. 2 the broken lines give the resistance of 1,900, 1,950 and 2,000 tons gross on a level, and also on a ½ per cent. rising gradient, and the combinations of load and speed, taken in connection with the dotted lines, will give the corresponding coal consumption per mile, under the conditions considered. As before, we will assume that no coal is used while running down hill.

We are now ready to construct a tabulated statement as previously for a variety of schedules, but the calculation will be rather more complicated than before. The different combinations of loads and speeds which we shall now study are shown below:

No.	Gross weight. Tons.	Speed uphill. m. p. h.	Speed downhill. m. p. h.	Speed on level. m. p. h.
1.	2,000	5	25	10
2.	1,950	10	25	10
3.	2,000	5	25	15
4.	2,000	5	25	25
5.	1,950	10	25	25

We will construct Table C on this basis. Lines 2 and 3 give the gross and net weight, respectively, as per the different schedules, and these values, multiplied by 150 (the length of the division in miles) give the ton mileage of the trip.

The time between terminals is figured as follows:—

SCHEDULE 1.

30 miles uphill at 5 miles per hour, require................	6 hours
30 miles downhill at 25 miles per hour require..............	1.2 hours
90 miles on level at 10 miles per hour require..............	9.0 hours
Add 20 per cent. for delays, etc..........................	3.3 hours
Total time between terminals..........................	19.5 hours

The average speed is therefore $\frac{150}{19.5}$ = 7.7 miles per hour.

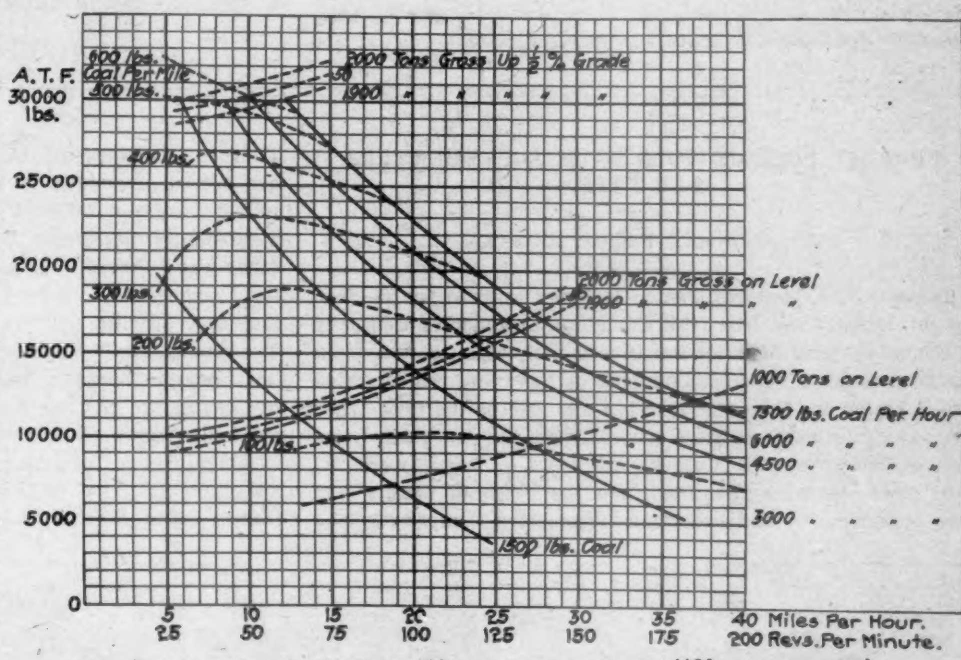


FIG. 2.—COAL CONSUMPTION OF 10-WHEEL LOCOMOTIVE (130 TONS WEIGHT).

TABLE C.

1.	Schedule of trip	1	2	3	4	5
2.	Weight of train, gross tons	2,000	1,950	2,000	2,000	1,950
3.	Weight of train, net tons	1,870	1,820	1,870	1,870	1,820
4.	Ton miles per trip, back of tender	280,000	273,000	280,000	280,000	273,000
5.	Time between terminals, including layouts	19.5 hrs.	15.8 hrs.	15.8 hrs.	13.0 hrs.	9.4 hrs.
6.	Average speed between terminals, miles per hour	7.7	9.5	9.5	11.5	16.0
7.	Coal burned, as calculated	....	....	....	....	....
8.	Coal burned per trip, lbs	25,800	28,350	26,250	34,800	36,900
9.	Cost of coal per trip, at $2 a ton	$25.80	$28.35	$26.25	$34.80	$36.90
10.	Locomotive supplies per trip, at 1½ cents per mile	2.25	2.25	2.25	2.25	2.25
11.	Train supplies per trip, at 1⅓ cents per mile	2.25	2.25	2.25	2.25	2.25
12.	Repairs to locomotive at 8 cents per 1,000 ton miles	22.40	21.84	22.40	22.40	21.84
13.	Repairs to cars at 15 cents per 1,000 ton miles	42.00	40.95	42.00	42.00	40.95
14.	Pay of enginemen, per schedule	13.65	11.20	11.20	10.50	10.50
15.	Pay of trainmen, per schedule	15.70	12.72	12.72	12.08	12.08
16.	Roundhouse labor at $2 a trip	2.00	2.00	2.00	2.00	2.00
17.	Interest on locomotive and caboose at 8⅓ cents per hour	2.08	1.77	1.77	1.53	1.22
18.	Total cost of trip, charges 9 to 17	$128.13	$123.33	$122.84	$129.81	$129.99
19.	Cost per 1,000 ton miles hauled	.45	.45	.44	.46½	.47⅓
20.	Ton miles hauled per month	8,228,000	9,450,000	9,700,000	11,200,000	13,650,000
21.	Lbs. coal per 100 ton miles	9.2	10.4	9.4	12.4	13.5

The remaining schedules are figured in the same manner and are given on lines 5 and 6.

The coal consumption is figured in a similar manner to the time, as follows:

SCHEDULE 1.

	Lbs.
30 miles uphill, 2,000 tons, at 5 m. p. h., 500 lbs. per mile....	15,000
30 miles downhill, 2,000 tons, at 25 m. p. h....................	
90 miles on level, 2,000 tons, at 10 m. p. h., 120 lbs. per mile..	10,800
Total coal for trip....................................	25,800

SCHEDULE 2.

	Lbs.
30 miles uphill, 1,950 tons, at 10 m.p.h., 600 lbs. per mile....	18,000
90 miles on level, 1,950 tons, at 10 m.p.h., 115 lbs. per mile....	10,350
Total coal for trip..........	28,350

SCHEDULE 3.

	Lbs.
30 miles uphill, 2,000 tons, at 5 m.p.h., 500 lbs. per mile......	15,000
90 miles on level, 2,000 tons, at 15 m.p.h., 125 lbs. per mile....	11,250
Total coal for trip..........	26,250

SCHEDULE 4.

	Lbs.
30 miles uphill, 2,000 tons, at 5 m.p.h., 500 lbs. per mile......	15,000
90 miles on level, 2,000 tons, at 25 m.p.h., 220 lbs. per mile....	19,800
Total coal for trip..........	34,800

SCHEDULE 5.

	Lbs.
30 miles uphill, 1,950 tons, at 10 m.p.h., 600 lbs. per mile....	18,000
90 miles on level, 1,950 tons, at 25 m.p.h., 210 lbs. per mile....	18,900
Total coal for trip..........	36,900

Lines 8 and 9 show the amount and cost of coal burned per trip. The other engine supplies and the train supplies are the same as in the previous cases, viz., 1.5 cents per mile, and are set down on lines 10 and 11.

Repairs are figured as before: 8 cents per 1,000 ton miles for locomotive and 15 cents for cars. Line 14, pay of engineers, is figured at 70 cents an hour for Schedule 1; at 150 miles and 1 hour overtime for Schedules 2 and 3, as the time was 0.8 over the time needed at 10 miles an hour. For Schedules 4 and 5 the 150 miles alone have to be paid for, as the average speed exceeds 10 miles an hour. For line 15, pay of trainmen, the same explanation holds good, except that according to the schedule of pay, numbers 2 and 3 are figured at 80.5 cents per hour for 15.8 hours. Roundhouse labor is still considered at $2 per turn or trip, as shown on line 16. As the 10-wheel engine will cost about 15 per cent. less than the heavier consolidation, interest will be charged at 8½ cents per hour, instead of 10 cents, as before, and 5 hours will be added to each value of line 5 in order to compute this charge. Thus, for Schedule 1, time between terminals is assumed at 19 5 hours, and, with time used in turning, makes 24.5 hours to a trip, and $24.5 \times .085 = 2.08$ per trip; the other schedules being computed in the same manner.

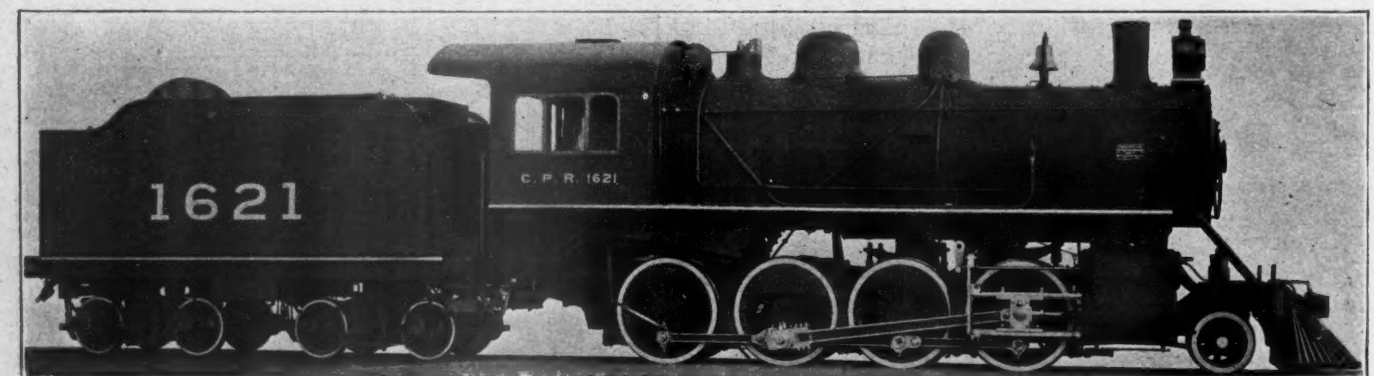
In line 18 we have the total cost of one trip, and it will be seen that there is little difference between the various schedules, although there is a great difference in the amount of work done during the month by the locomotive, Schedule 5 handling over 50 per cent. more traffic than Schedule 1, with a small increase in cost per ton mile.

(To be concluded.)

FREIGHT LOCOMOTIVES WITH SUPERHEATERS 2-8-0 TYPE.

THE CANADIAN PACIFIC RAILWAY.

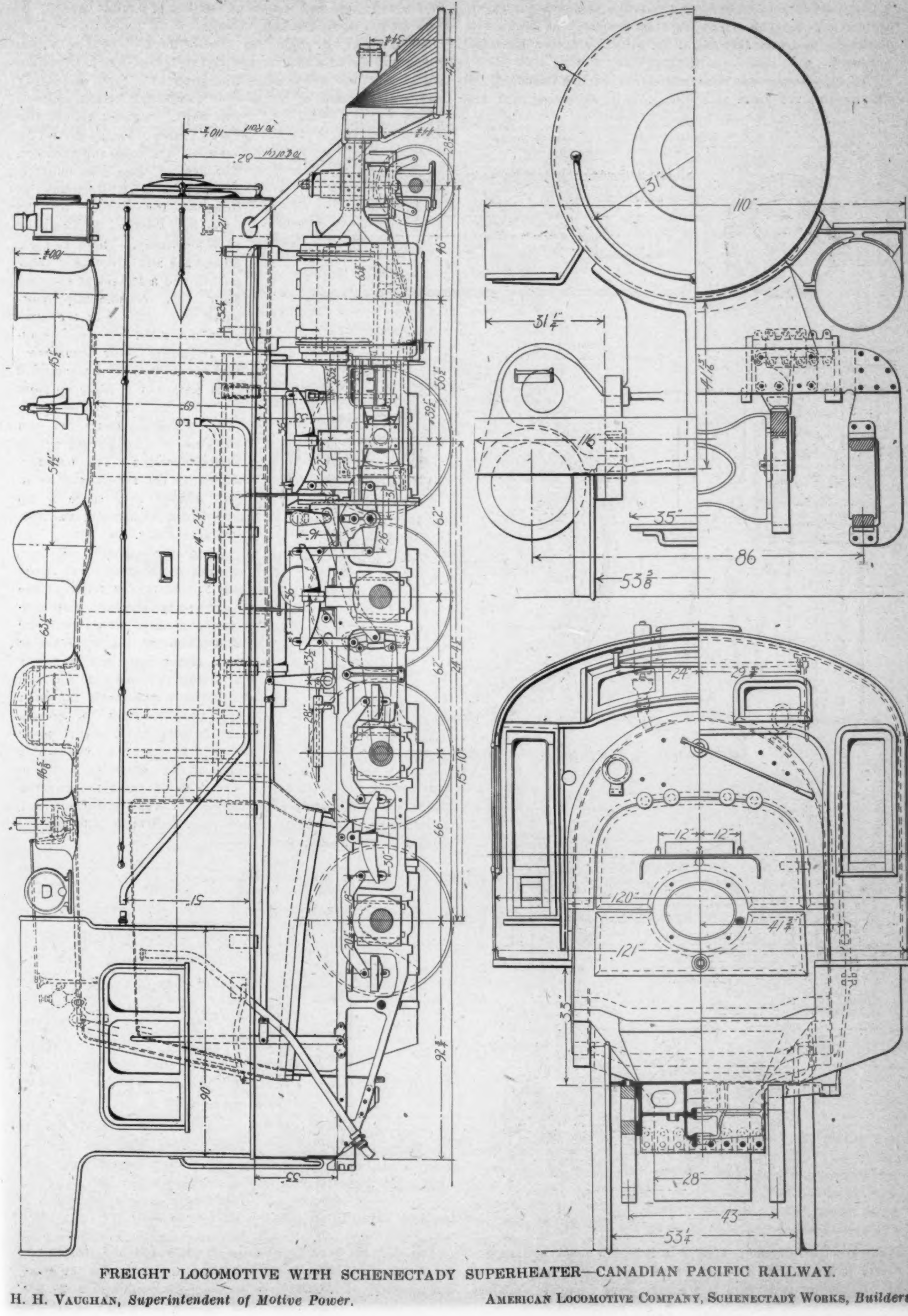
Recently the Canadian Pacific Railway ordered ten 2—8—0 freight locomotives from the Canadian Locomotive Company of Kingston, with Schmidt fire tube superheaters, eleven from the Locomotive & Machine Company of Montreal, ten of which had Schmidt fire tube superheaters and one of the Cole type; also twenty locomotives were ordered from the American Locomotive Company with Cole superheaters. These were all built from the same drawings, and the order of twenty has been completed by the American Locomotive Company at the (AMERICAN ENGINEER, January, 1904, page 12). The frames are braced diagonally by means of a steel casting at the rear pedestals of the forward drivers. They are braced again by a substantial casting at the front end of the mud ring. Among other good details are double suspension of the links, very long rocker boxes, three-point suspension leading trucks, liberal tube spacing with tubes at 2¾-in. centers at both ends. The circulation is also assisted by ample water spacing around the firebox. These locomotives have grates sloping towards the center to give as deep a throat as possible within the available limits. Outside piston valves are used in connection with double-bar frames, which, while slightly increasing the weight, will, it is hoped, tend to reduce the breakage of frames. The pedestal binders are exceedingly heavy, with



FREIGHT LOCOMOTIVES WITH SCHENECTADY SUPERHEATERS—CANADIAN PACIFIC RAILWAY.
H. H. VAUGHAN, *Superintendent of Motive Power.* AMERICAN LOCOMOTIVE COMPANY, SCHENECTADY WORKS, *Builders.*

Schenectady Works, the first engine being completed thirty days after the date of placing the order. Through the courtesy of Mr. H. H. Vaughan, superintendent of motive power of the Canadian Pacific Railway, illustrations of these engines are presented. The drawings were prepared at Schenectady under the direction of Mr. Vaughan, and the execution of this order in so short a time is in itself a remarkable achievement, which is referred to elsewhere in this issue.

This is an able freight locomotive of not excessive weight, with the boiler capacity augmented by the superheater. Apart from this it involves no experimental feature whatever. The reader will be reminded in this description of the Class C design of the Lake Shore & Michigan Southern Railway lugs 2¼ ins. deep. While ample heating surface is provided, no attempt was made to increase it at the expense of circulation about the firebox and among the tubes, or by an excessive height of the crown sheet. In general, more weight has been allotted to the machinery of this engine than is usual, and a high factor of adhesion (4.3) has been employed in an endeavor to obtain an engine which should be as free as possible from failures and breakdowns rather than one of the utmost capacity for its weight. The tender is designed to bring all of the coal to the fireman, with the sides of the greatest permissible height and fitted with iron coal gates. The center sills are heavy 13-in. channels and the side sills standard 10-in. channels. The draft castings are of cast steel, with Sessions-Standard friction draft gear at the rear end.



FREIGHT LOCOMOTIVE WITH SCHENECTADY SUPERHEATER—CANADIAN PACIFIC RAILWAY.

H. H. VAUGHAN, *Superintendent of Motive Power.* AMERICAN LOCOMOTIVE COMPANY, SCHENECTADY WORKS, *Builders.*

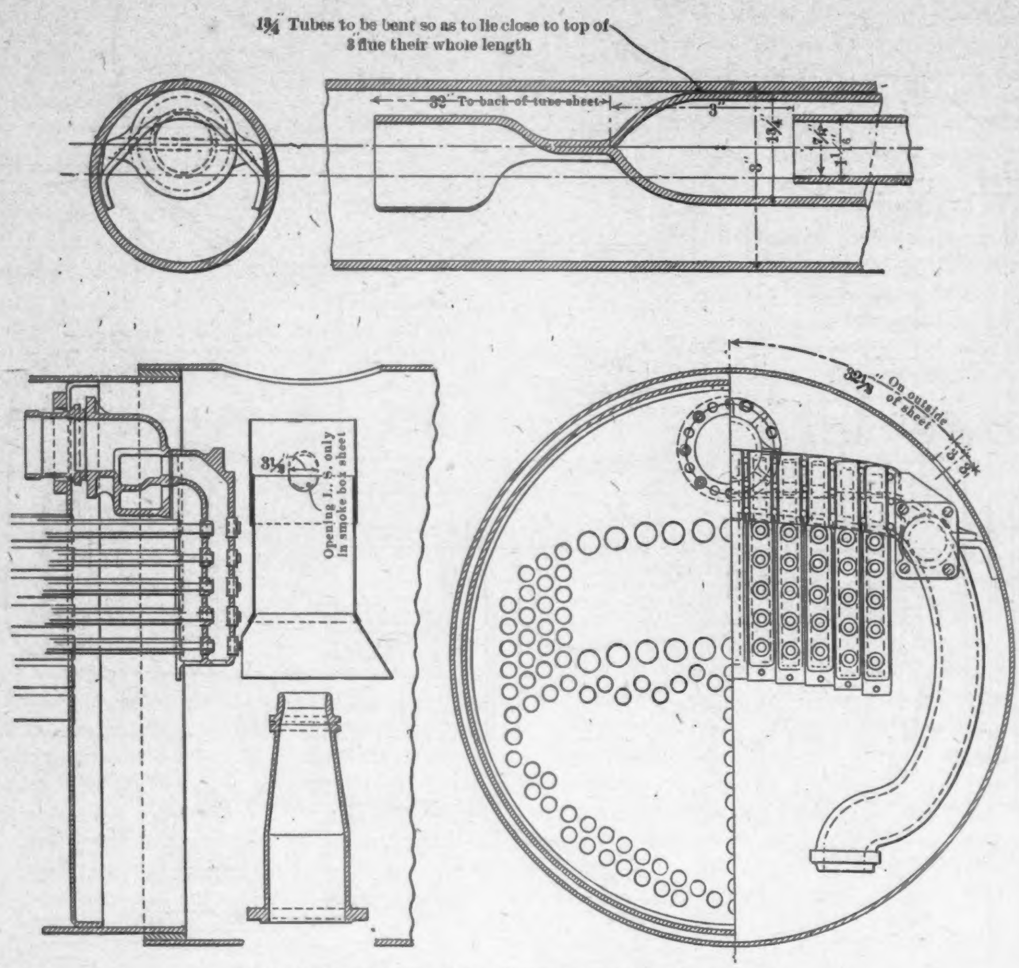
THE SUPERHEATER.

The chief feature of interest about this engine is the superheater; not because of its absolute novelty, but because it marks the first extensive use of the principle on the American continent.

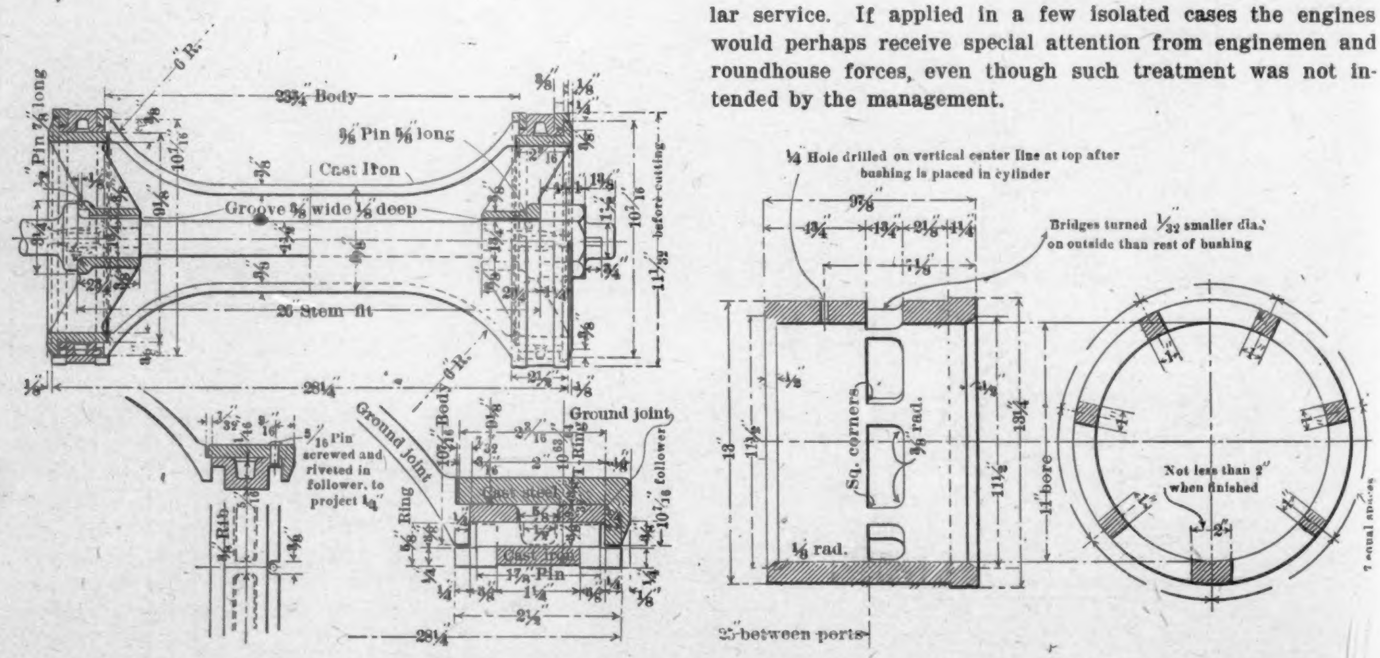
The superheater was first introduced on the Canadian Pacific about three years ago, when Mr. R. Atkinson, then mechanical superintendent, applied a Schmidt smokebox superheater to an 18 x 24, 4—6—0 freight engine, No. 548. During the succeeding two years this engine gave complete satisfaction and showed a decided and even remarkable fuel economy over both simple and compound engines of similar capacity in both freight and passenger service.

About a year ago engine No. 1,000 of the 4—6—0 type, a compound and one of a class of 40 freight engines, was built weighing 172,000 lbs. At the same time engine No. 1,300, of another and heavier class, of 40 4—6—0 compound freight engines, was built, weighing 190,000 lbs. These were equipped with Schmidt fire tube superheaters. The first of these was built by Neilson, Reid & Company of Glasgow, the second by the American Locomotive Company at Schenectady. These two engines have also given good satisfaction and a statement showing their fuel consumption compared with engines of the same class not fitted with superheaters is shown in the accompanying table. This is not compiled from tests, but is made up from the operating fuel records of the road, which accounts for the variation of economy during the various periods. The economy shown by the superheater is so well defined that there is no question of its effective and substantial saving.

When the question of purchasing more locomotives arose last Spring it was felt that the results so far obtained were sufficiently definite to warrant the application of the superheater on a larger scale and that only by doing this could this device be given a sufficiently thorough and practical test to develop any defects which might occur were it in use on a considerable number of engines in regular service. If applied in a few isolated cases the engines would perhaps receive special attention from enginemen and roundhouse forces, even though such treatment was not intended by the management.



CONSTRUCTION OF THE SCHENECTADY SUPERHEATER.



SECTIONS OF THE PISTON VALVE AND VALVE BUSHINGS.

The decision between the use of compound and simple engines was more difficult. It will be noted that taking the average economy of No. 548 over corresponding engines, at 30 per

cent. and the economy of No. 1000 and No. 1300 over corresponding compound engines, at from 15 to 20 per cent., the difference in this relative economy was about that which would be expected over a compound freight and simple engine. In other words the superheater engines, whether compound or simple, show about the same percentage of economy over an ordinary simple engine. This is in accord with the conclusions of Herr Garbe of the Prussian State Railways, who has been an extensive user of superheated steam in locomotives and claims that the difference in economy obtained by the compound engines using superheated steam is so small (not exceeding as a rule 5 per cent.) that it does not compensate for the increased complication involved. In view of these considerations it was decided that the class of engines to be built, in the new order for 41 engines, should be simple superheaters.

The cost of repairs, as shown in the statement, is not of very great value, as it does not of necessity represent the relative cost of maintaining engines using superheated or saturated steam, since the majority of reports received were not dependent upon that detail. In addition these reports do not simply represent maintenance charges, but include more or less shop repairs. Mr. Vaughan, however, states that the experience thus far gained would appear to show that the superheater engines will probably cost less for repairs than the others. Engine No. 548, which has just passed through the shops after making 75,000 miles, was in excellent condition and the piston valves were put back without requiring renewal of the rings, which are of the Schmidt design. All the pipes in the front end were found in good condition and it would appear that the dryness of the steam has a positive advantage since the additional added expense on that account is so slight that it is more than compensated for by the absence of water in the cylinders. The superheater on this engine, however, gives a greater degree of superheat than the firetube type of engines Nos. 1000 and 1300, but in the new engines the latter type are adopted on account of their simplicity.

No trouble has been experienced with the tubes containing the superheated steam and on one occasion, when leaks occurred between these tubes and the header in the front end, it was found that although the engine still steamed sufficiently well to handle its train, the leakage was easily detected, showing that in service leaks may be easily detected by water test. While these engines have been working in good water districts it is not believed that the large tubes containing the superheater pipes will give any serious trouble, and that while they need slightly more attention than the regular firetubes the decreased demands on the boiler reduces the amount of attention needed by the latter sufficiently to compensate for the additional work required on the larger tubes. The result is actually a net gain in the amount of boiler work required.

The accompanying tables present the general characteristics of the new engines, the records made by the superheaters previously in service and a comparison of the dimensions of the engines of which the record is given.

SUPERHEATER FREIGHT LOCOMOTIVES, 2-8-0 TYPE.
CANADIAN PACIFIC RAILWAY.

Weight in working order	190,000 lbs.
Weight in drivers	164,000 lbs.
Weight engine and tender	315,700 lbs.
Wheel base, driving	15 ft. 10 ins.
Wheel base, rigid	15 ft. 10 ins.
Wheel base, total	24 ft. 4¼ ins.
Wheel base, engine and tender	53 ft. 3½ ins.
Tractive Power	36,800 lbs.
Heating surface tubes	2,493.7 sq. ft.
Heating surface firebox	166.0 sq. ft.
Heating surface, total	2,659.7 sq. ft.
Grate Area	43.8 sq. ft.
Cylinders	21 by 28 ins.
Driving wheels, diameter	57 ins.
Driving wheels, centers	51 ins.
Driving journals, main	9½ by 12 ins.
Driving journals, others	9 by 12 ins.
Truck journals	6 by 11 ins.
Boiler, extended	wagon top
Boiler, pressure	200 lbs.
Boiler, diameter outside first ring	70⅝ ins.
Boiler, height of center above rail	110½ ins.
Fuel	bituminous coal
Firebox	96⅝ ins. long, 65¼ ins. wide
Water space	front 5 ins.; side 4½ ins.; back 3½ ins.
Tubes	length 14 ft. 2½ ins.
Tubes 2 ins. number	255
Tubes 3 ins. superheater	55
Smoke stack, diameter	16½ and 19 ins.
Smoke stack, above rail	15 ft. 3-16 ins.
Tender tank capacity	5,000 gals.
Tender coal capacity	12 tons

CANADIAN PACIFIC RAILWAY COMPARATIVE FUEL PERFORMANCE—ENGINES EQUIPPED WITH SUPERHEATER AND ENGINES NOT SO EQUIPPED.

Date	Engines With S. Heater	Engines Without S. Heater	Loco. Miles	Tons 1 Mile	Coal Tons	Ton Miles per ton of coal	Total Cost of Repairs	Total Miles of Engine	Cost per Mile for Repairs	REMARKS.	
MONTREAL AND SMITHS FALLS.											
May/03 to	548		34,493	33,183,463	1,541¾	21,531	693.26	37,692	1.1	Freight	Service
Dec. 31/03		482	31,857	30,456,884	1,741¾	17,490	1,209.77	33,563	3.6	"	"
8 Months.											
Jany. to	548		16,812	14,403,672	931	15,473	652.92	18,649	3.5	"	"
May/04		616	15,722	13,247,527	1,167	11,351	432.90	17,411	2.5	"	"
5 Months.											
June to	548		15,768	2,450,861	467¾	5,239	288.63	15,914	1.8	Passenger	"
September		595	16,128	2,560,092	600	4,267	242.83	17,525	1.4	"	"
4 Months.		634	16,854	2,749,553	680¼	4,042	618.65	18,403	3.4	"	"
Jany. to	1,000		21,567	25,321,322	1,271½	19,915	1,001.00	22,852	4.4	Freight	"
July/04		997	19,662	23,277,718	1,499¼	15,521	1,578.37	22,552	7.	"	"
7 Months.											
August and	1,000		3,740	4,657,142	188½	24,705	122.89	4,607	2.7	"	"
September		996	5,666	7,025,559	409¾	17,146	129.20	5,765	2.2	"	"
2 Months.											
CHALK RIVER AND NORTH BAY.											
Nov./03 to	1,300		22,987	17,074,757	1,127½	15,149	1,365.84	43,035	3.2	"	"
Sept./04		1,319	19,983	15,090,962	1,112½	13,560	1,679.42	43,561	3.9	"	"
11 Months.											
NORTH BAY AND CARTIER.											
Nov./03 to	1,300		10,964	9,887,253	550½	17,960				"	"
Sept./04		1,319	10,521	9,249,414	616½	15,002				"	"
11 months.											

CHARACTERISTICS OF LOCOMOTIVES IN SUPERHEATER PERFORMANCE RECORD.

Engine. No.	Type.	Kind.	System.	*Capacity.	Cylinders.	Drivers.	Heating Surface Fire Tubes & Firebox.	Super-Heating Surface sq. ft.	Grate Area.	Boiler Pressure.	Weight on Drivers, lbs.	Total Weight, lbs.	Similar Engines.
548	4-6-0	Simple Superheater	Schmidt Smokebox	100%	18 by 24	62	1,116 sq. ft.	307	23.44	180	96,800	124,000	
616	4-6-0	Simple		100%	18 by 24	62	1,291 sq. ft.		23.44	180	95,400	119,250	
595	4-6-0	Compound	2-Cylinder Pittsburgh	100%	20 & 30 by 24	62	1,291 sq. ft.		23.54	180	96,800	123,400	
634	4-6-0	Simple		100%	18 by 24	62	1,428 sq. ft.		28.54	180	94,350	119,325	
482	4-6-0	Compound	4-Cylinder Vauclain	105%	13½ & 23 by 24	62	1,614 sq. ft.		28.54	200	94,100	129,225	
1000	4-6-0	Compound Superheater	2-Cylinder Schmidt Fire Tube	135%	22 & 35 by 26	63	1,888 sq. ft.	350	33.02	210	129,000	172,000	
997	4-6-0	Compound	2-Cylinder Pittsburgh	135%	22 & 35 by 26	62	2,420 sq. ft.		33.02	210	128,000	169,000	
1300	4-6-0	Compound Superheater	2-Cylinder Schenectady Fire Tube	150%	22 & 35 by 30	62	2,492 sq. ft.	390	44.08	200	141,000	192,000	
1319	4-6-0	Compound	2-Cylinder Schenectady	150%	22 & 35 by 30	62	3,065 sq. ft.		44.08	200	141,000	190,000	

* 100% = 20,000 lbs. draw-bar pull.

POWER REQUIRED BY MACHINE TOOLS.

The following formulæ represent average American practice, so far as the horsepower required to drive various machine tools under normal operation is concerned and are intended only as a guide in preliminary estimates based on normal conditions and normal machines. Formulæ based on the size of belts used generally call for too large a motor and are not as accurate as the following formulæ, which are taken from actual practice. The conditions under which machine tools operate are so varied that it is impossible to make any general statements which will enable all of the conditions to be taken into account. The formulæ have been based on the assumption that tools made of water hardened steel are used, and the average cutting speed has been taken in the neighborhood of 20 ft. per minute. Where high speed tool steels are used it is necessary to analyze the problem from the cut to the motor and no rule can now be made except on the basis of cutting speeds expressed in proportion to cutting speeds from the water hardened steels. Recent observations, however, indicate that the increase in power required with the high-speed tool steels is not so great as the increase in output secured.

Broadly speaking, machine tools may be divided into two

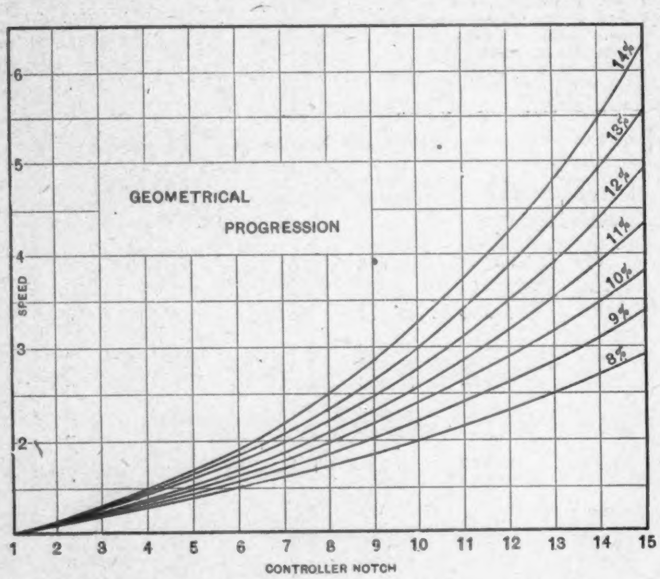


DIAGRAM SHOWING INCREASE OF SPEED BY GEOMETRICAL PROGRESSION.

classes: Those with direct rotary motion of either work or cutter, and those with reciprocating motion of either work or cutter. Under the first head come lathes, boring mills, milling machines, drill presses, etc., while the second class comprises planers, shapers, slotters, and machines of similar character. Under abnormal conditions, any of the machines covered by the formulæ are capable of absorbing horse-power in excess of those given; but such conditions must be considered abnormal, and motors specified with this point in view. In general, whatever the class of machine tool, the variable speed motor has decided advantages in the way of economical production. With the old method of speed variation by means of cone pulleys or nests of gears, coarse increments in speed only can be obtained. This invariably means that the machine tool cannot be worked up to its limit of productive capacity. With the new high speed steels, necessitating greater pulling power in belts and increased strength in gears, reasonably fine increments in speed are almost impossible, due to the increased length of the cone pulley, or the abnormally large size of the change gears required to obtain the necessary speed increments. For this reason the variable speed motor may in some cases actually decrease the cost of the machine tool by eliminating extremely bulky and expensive mechanical speed changing devices.

The approved practice in the matter of cutting speeds is to make the ratio between the various speeds increase in geometrical progression, and as it is somewhat laborious to calculate in each case what the speeds will be on the different controller notches, the curve shown in the diagram has been prepared, with the hope that it may be of some service. This curve has been laid out on the basis of standard Westinghouse practice, in which the number of notches on the single voltage is 8, while on the double voltage 15 notches are used. The vertical represents the total increments in speed, the horizontal, the controller notches; while the curved lines each represent a certain percentage of the increase between the notches. For example: On the 15th notch of the controller, having 14 per cent. increments, the speed will be 6.25 times the initial speed.

In general, the handle of the controller used in connection with variable speed motors should be located convenient to the operator, as, for example, in the case of a lathe, good practice places the handle on the tool carriage. Connection between the controller handle and the controller proper should be made as rigid as possible, in order that the notches on the dial of the controller may correspond as nearly as possible to definite running positions on the controller. In general, the motors to be used for lathes, boring mills, drill presses, etc., should be shunt wound, variable speed, d. c. motors, with good inherent speed regulation.

In general, if high speed tools are used, running at a higher cutting speed than that given, the increase in horse-power should be approximately proportional to the increase in speed.

Engine lathes using one cutting tool of water hardened steel at about 20 ft. per minute: H.P. $= .15\ S - 1$ h.p. Heavy engine lathes, such as forge lathes: H.P. $= .234\ S - 2$ h.p., where $S =$ swing of lathe in inches.

For the operation of standard boring machines using one cutting tool of water hardened steel at approximately 20 ft. per minute, the following formula will be found to represent good practice for heavy work: H.P. $= .25\ S - 4$ h.p., where $S =$ swing of mill in inches.

For normal slab milling machines using water hardened steel cutters running at about 20 ft. per minute, the following formula will be found useful: H.P. $= .3\ W$, where $W =$ distance between housings in inches.

For normal drill presses using water hardened steel drills, running at a peripheral cutting speed of approximately 20 ft. per minute: H.P. $= .06\ S$. For heavy radial drill presses: H.P. $= .1\ S$, where $S =$ capacity of drill press in inches.

Machines for reciprocating motion are from their nature less productive than those having a purely rotary motion of either cutter or work and for this reason it is especially important that they be run to the limit of their capacity. They require variable speed motors, similar to the one described in connection with rotary motion machines, except that the motor should be compound wound. The compound wound motor is useful in that at the instant of reversal, when the torque required of the motor increases very considerably above the normal, the compound winding assists materially in holding the inrush of current within reasonable limits, and this may be further improved by the use of a flywheel.

The following figures show average practice, so far as horse-power required for operation of some of the typical reciprorating machines is concerned.

Normal crank slotters, using water hardened steels at cutting speeds of from 15 to 20 ft, per minute: Stroke 10 ins., h.p. 5; stroke 18 in., h.p. 7; stroke 30 in., h.p. 10.

Shapers using water hardened tool steels at cutting speeds of from 15 to 20 ft. per minute: Stroke 16 ins, h.p. 3; stroke 18 ins., h.p. 3½; stroke 24 ins., h.p. 5; stroke 30 ins., h.p. 6½.

For normal planers using water hardened steels at cutting speeds of from 15 to 20 ft. per minute; H.P. $= 3\ W$, where $W =$ width between housings in feet. For heavy forged planers: H.P. $= 4.92\ W$. These formulæ are for planers having a ratio of cutting to return speeds of approximately 1 to 3, and cover planers with two tools in operation. If more than two tools are used, or if the ratio between the forward and return speeds is more than 1 to 3, the horse-power given by above formula should be increased.

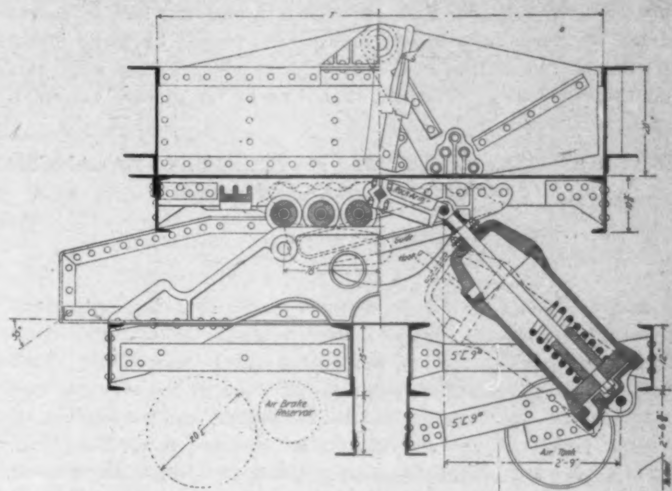
These formulæ have been compiled from recent successful practice by the industrial and power department of the Westinghouse Electric & Manufacturing Company.

KING-LAWSON DUMPING CARS.

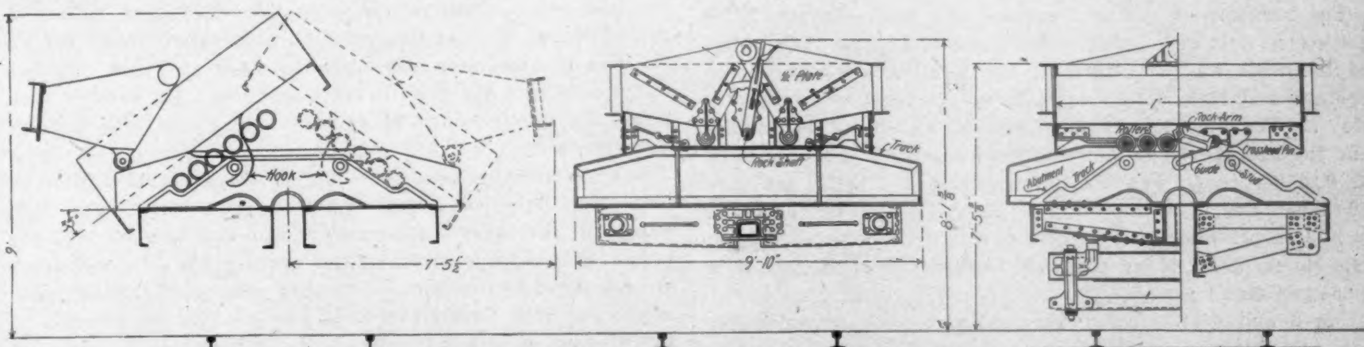
In this journal for April, 1904, page 137, the Lawson dumping car was illustrated. An improvement produced jointly by Mr. George I. King, of the Middletown Car Works, and Mr. Thomas Lawson is illustrated by these engravings. This car, which was built by the Middletown Car Works, Middletown, Pa., has a single box, dumping upon either side of the track. This car has been put into trial service on the Delaware, Lackawanna & Western Railroad. It dumps by dynamic action rather than by gravity. The box is moved 18 in. laterally from its normal position and then tipped until it comes forcibly against stops, which will shake out a refractory load, such as wet clay. The principal dimensions are given in the following table:

DIMENSIONS.

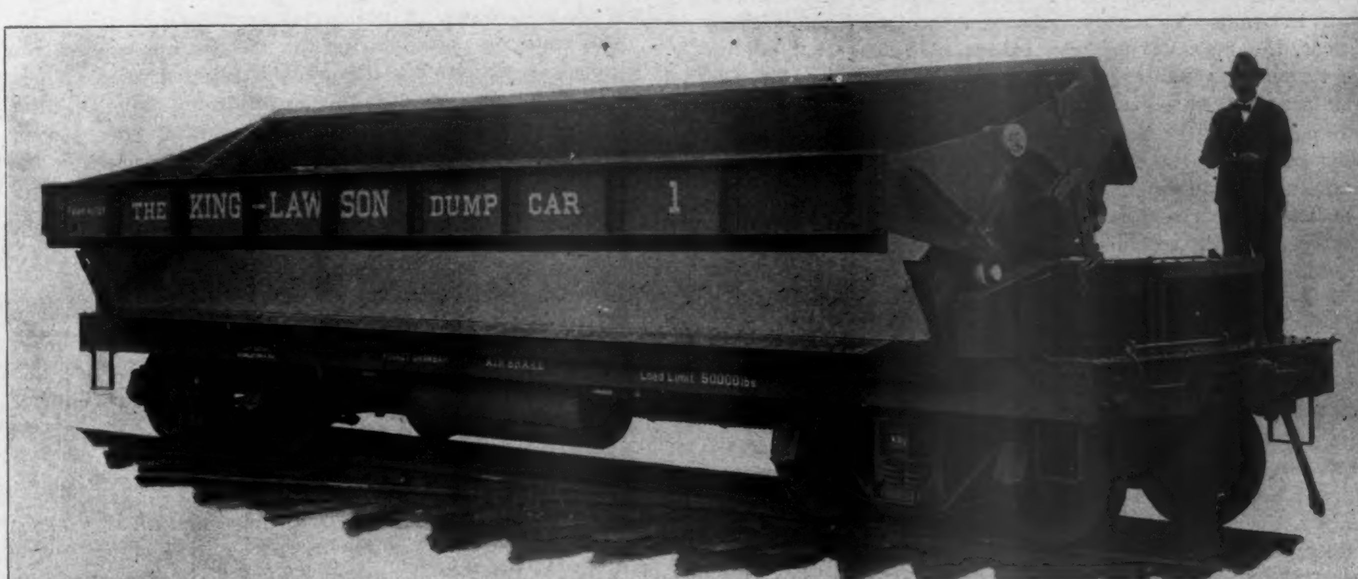
Contents of box level full	327 cu. ft.
Contents of box with 30 degree heap	515 cu. ft.
Nominal capacity	50,000 lbs.
Approximate weight	47,000 lbs.
Length over end sills	34 ft. 0 ins.
Length inside of box	28 ft. 0 ins.
Center to center of trucks	24 ft. 0 ins.
Truck wheel base	5 ft. 6 ins.
Width over side sills	8 ft. 6 ins.
Width over all	9 ft. 10 ins.
Inside width of box	7 ft. 0 ins.
Inside height of box	1 ft. 8 ins.
Height from rail to top of side sill	3 ft. 6¾ ins.
Height from rail to top of door	7 ft. 5⅜ ins.
Height over all	8 ft. 1⅝ in.
Height from rail to center of drawbar	2 ft. 10½ ins.



THE KING-LAWSON DUMP CAR—OPERATIVE DETAILS.



THE KING-LAWSON DUMP CAR—VARIOUS POSITIONS.



THE KING-LAWSON DUMP CAR.

The box is of steel mounted on three cast steel race rails and tipped by means of two pairs of pneumatic cylinders, connected with the train pipe. Two operating valves are connected to a reverse lever by means of which the respective pairs of cylinders are brought into use. Built up body bolsters are connected to 12-in., 25-lb. channel side sills, and 13-in., 33-lb. channel center sills. The end sills are ¼-in. plates bent to Z form and riveted to the longitudinal sill, and ¼-in. platform plates. A ¼-in. plate is used to reinforce the center sills. Connecting the side and center sills are 2 pairs of channel trussses and between the members of each pair 12-in. cast iron cylinders are hinged. These cylinders take air from 2 large storage tanks. Ten lbs. pressure will dump the car when empty and from 55 to 60 lbs. will be required when loaded.

The box is built on a steel frame with a floor of a single ⅜-in. plate. Each door is a ⅜-in. plate with flange angles. Attached to each end of each door is a heavy ½-in. plate hinged on a bracket carried by the box end at its center. The door in its normal position is carried by this bracket and the floor of the box. In dumping, the door rolls on two steel girders car-

ried by the underframe of the car and is entirely automatic in its action. The box is supported upon 18 cast steel grooved rollers having antifriction bearings and rolling upon the cast steel race rails.

In dumping, a squared rock shaft lying under the center of the box is turned to the right or left and disengages locks permitting the box to move to the right or left. Air is then admitted to the proper pair of cylinders and the box is moved along the race rails to one side until stopped by large hooks on the bottom of the box, coming into contact with stop pins on the race rails. The box then tips under further action of the cylinders until stops on the box frame come into contact with the rail abutments. Springs in the cylinders protect these parts from shock and it is clear that the rollers are also protected from damage.

This car has been dumped on the low side of a track of which one rail was elevated 3½ ins. above the other. A load of 30 tons of pig iron mixed with car wheel scrap has been dumped in 30 seconds and 25 tons of water-soaked clay in 15 seconds, both loads being thrown entirely outside of the rails. From experiments, Mr. King believes this type of construction to be entirely satisfactory for loads up to 30 tons.

INSTRUCTIVE TESTS OF A BALDWIN BALANCED COMPOUND LOCOMOTIVE.

Burlington & Missouri River Railroad.

Engine No. 2,700, a Baldwin four-cylinder balanced compound, built for the Chicago, Burlington & Quincy, was illustrated in this journal in September, 1904, page 356. This engine has given remarkably good results in service, and through the courtesy of Mr. R. D. Smith, superintendent of motive power of the Burlington & Missouri River Railroad, results of tests comparing this with three simple engines on that road are presented. These results will cause even increased interest in this balanced compound.

The numbers of the four engines and their characteristics are stated in the comparative table of dimensions. The object of the tests was to determine the relative economy of the engines and their ability to fulfil the requirements on Train No. 1. The distance from McCook to Akron is 142.9 miles, and the average grade between these points is 15 ft. per mile, or 0.28 per cent. The maximum grades are 34 ft. per mile (0.64 per cent.). From Wray to Akron, 53.5 miles, the grade is 21.3 ft. per mile (0.4 per cent.), and from Wray to Eckley, 14.8 miles, there is an unbroken stretch of 34 ft. per mile (0.64 per cent.) grade.

Speed and drawbar pull were taken by the dynamometer car. An observer on the engine noted the steam pressure, injector applications, smokebox temperature and water drawn from the tank. The water measurements were taken from a float, the tank having been calibrated. The coal put on the tender was obtained from track scale weights, and that remaining at Akron was weighed on platform scales, the difference being the amount consumed on the tests. No indicator cards were taken, but the indicated tractive force was computed as follows:

Indicated tractive force equals (1) drawbar pull plus (2) engine, frictional and head resistance plus (3) engine grade resistance plus (4) resistance due to bringing the engine from a speed of zero miles per hour to the speed at which the engine was "shut off," times the number of starts. The first item is known from the dynamometer record, the second was obtained from the results of previous tests, and the third and fourth items are matters of mathematical computation. This gives the indicated horse-power to within a very small error, but of course shows nothing about steam distribution, which could be obtained only by indicator cards.

Train No. 1 usually consists of 7 cars, as follows: Mail, baggage, coach, chair car, diner, and two Pullman sleepers. This train makes three regular intermediate stops at Benkleman, Wray and Yuma. The schedule time is 3 hours 36 minutes, including the stops, or 39.7 miles per hour. Deducting 14 minutes for the stops, the average speed is 42.5 miles per hour.

Test of Engine No. 2,700.—This is an Atlantic type four-cylinder balanced compound, with 15 and 25 by 26-in. cylinders, 78-in. drivers and 3,206 square ft. of heating surface. On the tests of this engine the train was purposely delayed at Benkleman and Wray, in order to give an opportunity for making up time. On one test an extra stop was made at Wray on account of a freight train in the way. The time made up on this test with 8 cars was 16 minutes. On another test with 10 cars 28 minutes were made up. On another test with 12 cars running time was made with one extra stop.

Test of Engine No. 1,741.—This is a Prairie type simple engine, with 21 by 26-in. cylinders, 69-in. drivers and 3,080 square ft. of heating surface. On all the tests the train was late at McCook, and from ½ to 6½ minutes were made up.

Test of Engine No. 3,703.—This is an Atlantic type simple engine, with 20 by 26-in. cylinders, 78-in. drivers and 2,990 square ft. of heating surface. On one test 1½ minutes were made up, and on two tests (all with 8 cars) 2 and 8 minutes were lost, respectively.

Test of Engine No. 3,701.—This engine is like No. 3,703, except that the driving wheels are 84¼ ins. in diameter. This one had 1-16-in. positive lead in full forward gear instead of the ordinary valve setting off 1-16-in. negative lead. On all its runs an extra stop was made for water at Yuma. On one test with 8 cars 8½ minutes were made up. On another with 8 cars 7½ minutes, and on another with 9 cars 11½ minutes were made up.

In discussing the results the engine may be divided into two parts, the boiler and the cylinders. The boilers are compared by the water evaporated, from and at 212 deg. per pound of coal for a given rate of evaporation. The cylinders are compared by the amount of steam used per indicated horse-power per hour at a given horse-power. The combination of the amount of steam furnished the cylinders by a pound of coal and the economy with which the cylinders use it determines the horse-power of the engine as limited by the boiler. On these tests the engine having the greatest horse-power run at a given speed develops the greatest tractive force. There are, however, two limits to the variations of tractive force and speed which combine to produce a constant horse-power; one is the tractive force at starting, which does not allow the engine to develop full horse-power at low speeds and the other is the maximum speed at which the steam may be worked through the cylinders.

Results.

Considering the locomotives as a whole, without separating the boiler and cylinder performance, the comparative standing is as follows:

Engine No.	Rank.	Comparative Efficiency.	Coal per I. H.P. Hour.	Average I. H. P.
2700	1	100%	4.30	1,122
1741	2	93%	4.64	966
3703	3	87%	4.96	895
3701	4	85%	5.05	927

If the engines are compared by cylinder performance alone the following figures are obtained:

Engine No.	Rank.	Water consumed per I. H. P.	Water consumed per Draw-bar H. P.
2700	1	24.37 lbs.	36.78
1741	2	30.10 lbs.	46.11
3701	3	30.41 lbs.	49.54
3703	4	30.45 lbs.	48.30

It is apparent that for all engines except No. 2,700 the water rate is about 30 lbs. per indicated horse-power, the average being 30.45 lbs., while No. 2,700 used only 24.37 lbs. This saving of over 20 per cent. over the simple engines includes the figures from test No. 121, on which the compound was overloaded by a 12-car train, which it hauled on time. If this test is left out of consideration, the normal water rate for the balanced compound is 22.86 lbs. of water per indicated

horse-power hour, or a saving of 25 per cent. over the consumption of the simple engines.

The figures with reference to the evaporative duty of the boilers are as follows:

Engine No.	Heating Surface.	Water per hour from and at 212 deg. Total.	Per sq. ft. Heating Surface.	Per pound of coal
1,741	2,770 sq. ft.	37,530	13.55 lbs.	7.8 lbs.
3,703	2,650 sq. ft.	33,784	12.75 lbs.	7.4
3,701	2,650 sq. ft.	36,506	13.78 lbs.	7.22
2,700	2,881 sq. ft.	34,448	11.96 lbs.	6.78

Other conditions concerning combustion are as follows:

Engine No.	Draft Vacuum.	Flue Gas Temperature.	Flues. Length.	Flues. Diameter.	Steam per I.H.P. Hour.
1741	7.1 in.	765 deg.	18 ft. 4 in.	2¼	30.10
3703	6.7 in.	705 deg.	16 ft. 6 in.	2	30.45
3701	6.1 in.	700 deg.	16 ft. 6 in.	2	29.92
2700	4.8 in.	718 deg.	19 ft. 0 in.	2¼	24.37

As there was no coal record on test No. 122 with engine No. 3,701, the figures for this test are omitted in these averages.

It will be noticed that engine No. 2,700 shows the least economical evaporation, although the smokebox vacuum is the lowest and the flues are the longest. Of the other engines, No. 1,741, with long flues and high smokebox vacuum, gives the highest evaporation per pound of coal. In connection with the poor showing of the boiler of No. 2,700, it is worthy of mention that the crew was a new one for each day, and it was each fireman's first trip on the compound engine. No. 2,700 being a compound, and therefore having a lower water rate, uses from 20 to 25 per cent. less steam per indicated horse-power and still less coal than the simple engines.

With the same sized boiler, consequently, on his first trip with the locomotive a fireman is likely to fire too heavily. During a test there were sometimes two or three different men running the engine, which does not tend to improve the quality of the firing. It is quite possible that the draught on this engine could be increased with good results as to the economy of the evaporation.

THE BEST LOCOMOTIVE.

To meet the requirements of the service engine No. 2,700 stands first on account of its low water rate. The low water rate gives it effectively a boiler of over 25 per cent. larger capacity than if it were a simple engine, or if this engine had simple cylinders a tank of 8,000 gals. would be the equivalent of the 6,000 gal. tank and compound cylinders. The low water rate and effectively larger boiler give the engine a higher horse-power which is needed at high speed, and this engine can run at a sustained high speed, not being limited by cylinder and valve motion design. The high horse-power and the ability to attain high speed combine to give this engine reserve capacity, which is very much needed on the McCook-Akron section in case additional cars are put on the train or when high winds or late trains are to be dealt with.

These tests were conducted by Mr. J. G. Crawford under the direction of Mr. Max H. Wickhorst, engineer of tests of the Chicago, Burlington & Quincy Railway.

DESCRIPTION OF LOCOMOTIVES TESTED, McCOOK TO AKRON, 1904.

Engine number	1741	3703	2700	3701
Class	R3	P2	P3 Comp.	P2
Wheel arrangement	2-6-2	4-4-2	4-4-2	4-4-2
Service	Freight or passenger	Passenger	Passenger	Passenger
Builder	Baldwin	Rogers	Baldwin	Rogers
Boiler type	Belpaire	Extended wagon top radial stay	Extended wagon top radial stay	Extended wagon top radial stay
" small diameter	65¼ ins.	65⅝ ins.	64 ins.	65⅝ ins.
" steam pressure, pounds	200	210	210	210
Fire box—Length	84 ins.	96⅛ ins.	96⅛ ins.	96⅛ ins.
" Width	72 ins.	66¼ ins.	66¼ ins.	66¼ ins.
" Height, front and rear	66¼ ins., 63¼ ins.	70⅝ ins., 68⅝ ins.	70⅝ ins., 68⅝ ins.	70⅝ ins., 68⅝ ins.
Grate area, square feet	42	44.14	44.14	44.14
Tubes—Number	272	330	274	330
" Diameter outside	2¼ ins.	2 ins.	2¼ ins.	2 ins.
" Diameter inside	2.01 ins.	1.76 ins.	2.01 ins.	1.76 ins.
" Length	18 ft. 3 11-16 ins.	16 ft. 6 ins.	19 ft. 0 ins.	16 ft. 6 ins.
Heating Surface—Fire box, sq. ft.	173.6	155.5	155.5	155.5
" Tubes, inside surface	2,596.4	2,494.5	2,725.5	2,494.5
" Total	2,770.0	2,650.0	2,881	2,650.0
" Tubes, outside surface	2,906.6	2,834.5	3,050.5	2,834.5
Total	3,079.6	2,990.0	3,206	2,990.0
Cylinders—diameter and stroke	21 in. x 26 in.	20 ins. x 26 ins.	15 ins & 25 ins. x 26 ins.	20 ins. x 26. ins.
Valves	12-in. Piston	12-in. Piston	15-in. Piston	12-in. Piston
Wheels—Driving, diameter	69 ins.	78 ins.	78 ins.	84¼ ins.
" Truck, diameter	37¼ ins.	33 ins.	33 ins.	37¼ ins.
" Trailing, diameter	42½ ins.	48 ins.	48 ins.	54¼ ins.
Wheel base—Driving	13 ft. 0 ins.	7 ft. 3 ins.	7 ft. 3 ins.	7 ft. 3 ins.
" Engine	28 ft. 3 ins.	27 ft. 7 ins.	30 ft. 2 ins.	27 ft. 7 ins.
" Engine and tender	55 ft. 8½ ins.	55 ft. 0¼ ins.	57 ft. 7¼ ins.	55 ft. 0¼ ins.
Weight—On drivers	131,000	91,250	92,000	91,250
" Of engine	180,500	187,000	196,600	187,000
" Of engine & tender, ½-load	263,900	270,400	280,000	270,400
Exhaust nozzle—tip diameter	5 ins.	5 ins.	5⅝ ins.	5 ins.
Tender—Water capacity, gallons	6,000	6,000	6,000	6,000
" Coal capacity, tons	12	12	12	12

SPIRALLY CORRUGATED BOILER TUBES.

Because of the interest expressed at the Master Mechanics' Association Convention last June in spirally corrugated boiler tubes for locomotives, inquiry has been made by the editor concerning their operation in service from several railway officials who are using them. Last month a letter from one of these gentlemen was presented, and with the permission of Mr. G. W. West, superintendent of motive power of the New York, Ontario & Western Railway, the following opinion, representing experience on that road, is given:

"We have been running one set of the corrugated boiler tubes for four or five years, and can only speak of them with praise. We have recently put in the second set in one of our wide firebox boilers, and have every reason to believe that they will lessen our trouble with leaky flues. We had some doubt on the start of our being able to keep the flues clean, thinking that the corrugation would clog the flues, but have had no more trouble in the clogging of flues with the corrugated tubes than with the plain ones. We know the flues require less attention than plain tubes, and I believe these tubes will keep a lot of boiler makers out of the roundhouse."

"The only thing I can add to the statement made to you some time ago in regard to the corrugated tubes is that the reports from the wide firebox boiler in one of our consolidation engines are to the effect that the engine steams more freely, uses less water and coal than others of the same class, and that there has been no trouble whatever with leaky tubes as yet."

Self Propelled Vehicles, a Practical Treatise on the Theory, Construction, Operation and Management of Automobiles. By James E. Homans, 652 paages, illustrated. Theo. Audelo Company, 63 Fifth avenue, New York, 1904. Price $2.00.

This is the second edition of this interesting book. It is valuable to the student of machinery who desires information on the methods of automobile builders, to the user of the machines, to those who are concerned in the development of internal combustion engines and to the reader who is merely interested in an important mechanical development. The author is thorough. He describes many typical constructions, goes into the theory of gasoline engines and into transmission gearing and other essentials of these machines. He presents an excellent chapter on steam automobile boilers and treats every subject for which a book would be consulted. The work is well indexed.

ELECTRIC LOCOMOTIVE TEST.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

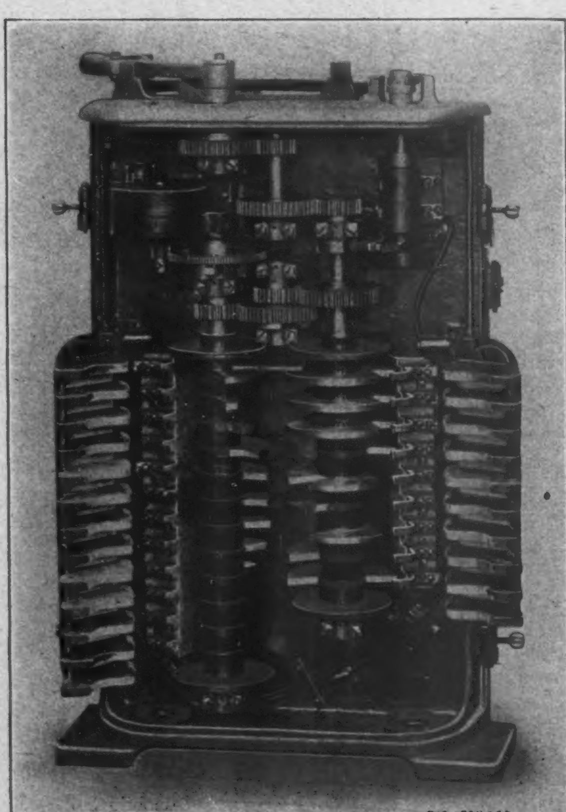
On November 12th the powerful highspeed electric locomotive designed and built by the General Electric Company and the American Locomotive Works for the New York Central & Hudson River Railroad was exhibited and tested in the presence of the Electric Traction Commission of the railroad and their guests.

The results of the trial were extremely satisfactory. This is the most important development which has taken place in this direction and this article will be followed by one in our next issue describing the construction of the locomotive in detail.

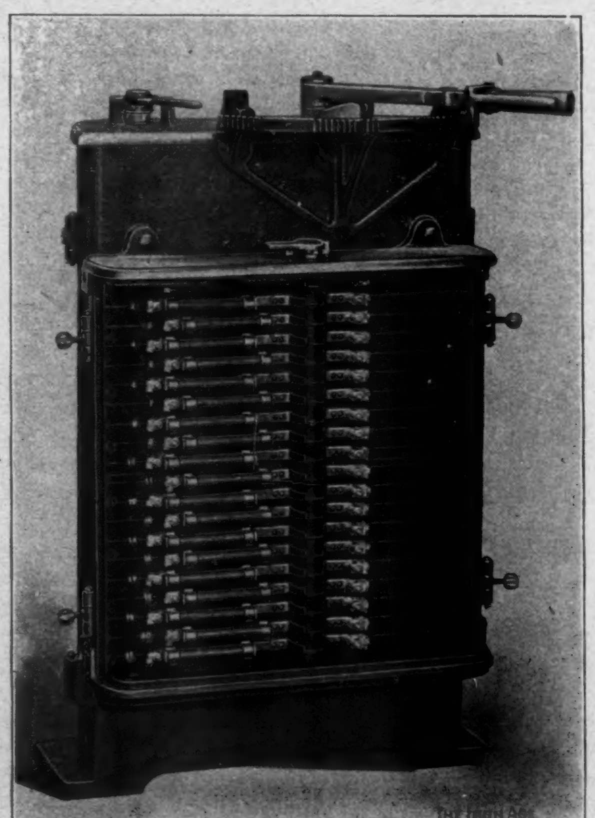
GENERAL DIMENSION AND DATA.

Number of driving wheels	8
Number of pony trucks	2
Weight on drivers	69 tons
Total weight	95 tons
Rigid wheel base	13 ft.
Total wheel base	27 ft.
Length over buffer platforms	37 ft.
Extreme width	10 ft.
Height to top of cab	14 ft. 4 ins.
Diameter of drivers	44 ins.
Diameter of pony truck wheels	36 ins.
Diameter of driving journals	8½ ins.
Normal rated horsepower	2,200
Maximum horsepower	3,000
Normal drawbar pull	20,400 lbs.
Maximum starting drawbar pull	32,000 lbs.
Speed with 500-ton train	60 m.p.h.
Voltage of current supply	600
Normal full load current	3,050 amperes
Maximum full load current	4,300 amperes
Number of motors	4
Type of motor	GE-84-A
Rating of each motor	550 h.p.

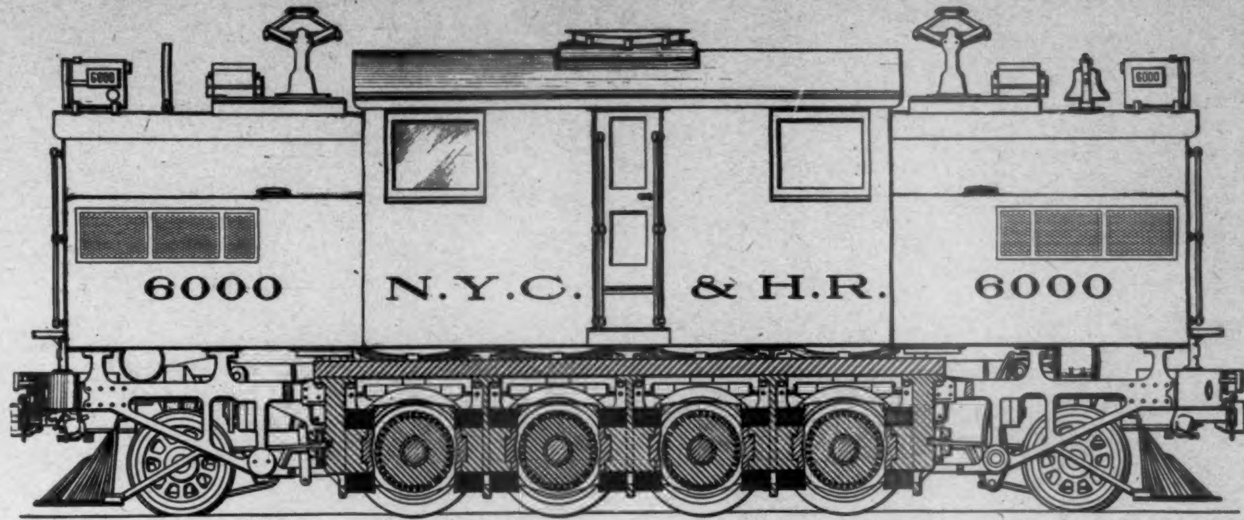
NEW YORK CENTRAL ELECTRIC LOCOMOTIVE WITH TRAIN.



CONTROLLER WITH COVER REMOVED, SHOWING INTERIOR.



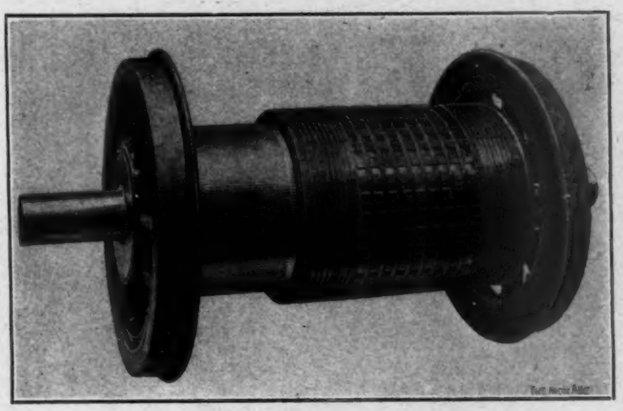
REAR VIEW OF CONTROLLER, SHOWING FUSES AND CUT-OUTS.



NEW YORK CENTRAL ELECTRIC LOCOMOTIVE—LONGITUDINAL SECTION THROUGH FRAME.

The New York Central & Hudson River Railroad Company is now electrically equipping its New York terminal for a distance of 34 miles on the main line from the Grand Central station to Croton, and for 24 miles on the Harlem Division as far as White Plains. It is the intention to handle all the traffic within this district electrically and this locomotive is one of from 30 to 50 which will be used in hauling the through passenger trains, the heaviest of which weigh 875 tons and must run at a maximum speed of 60 to 65 miles per hour.

By the use of the Sprague-General Electric multiple unit system of control, two or more locomotives can be coupled together and operated from the leading cab as a single unit. The motive power may therefore be easily adapted to the weight of the train with no complication in operation and with



ONE OF THE ARMATURE-AXLE UNITS.

uniform make-up of train crew. A single electric locomotive will be able to maintain the schedule with a 450-ton train, two locomotives being coupled together for heavier trains.

In the tests the locomotive developed remarkably easy riding qualities at high speeds and during acceleration. The designers have secured the best mechanical features of the high speed steam locomotive combined with enormous power and simplicity of control made possible by the use of the electric drive.

It is the intention of the railroad company and the General Electric Company to make complete preliminary tests and trials on these locomotives under all conditions likely to obtain in service operation. For this purpose the railroad company has set aside a 6-mile stretch of track on its main line between Schenectady and Hoffmans and equipped it with standard third rail construction. The track is practically straight and ballasted so as to permit a maximum speed of 70 to 80 miles per hour being attained.

Power for operating the locomotive is furnished by the General Electric Company, and for this purpose there has been installed in the new power house at the Schenectady plant a 2,000 k.w., three phase, 25 cycle, Curtis turbo-generator delivering 11,000 volts to the line. A special high tension transmission line has been constructed from the power station for a distance of 5 miles to the substation at Wyatts. This substation contains a 1,500-k.w., 650 volt, 25 cycle General Electric rotary converter with necessary static transformers for reducing the line potential from 11,000 to 460 volts, and a switchboard consisting of a 600-volt d.c. rotary converter panel, an a.c. starting panel and a high tension panel with electrically operated type H oil switch. The rotary converter is self-starting from the a.c. end, thus requiring no synchronizing or other complication when throwing the machine into service. The stepdown transformers are provided with taps giving 1-3, 2-3 and full voltage for starting the rotary converter, these voltages being applied successively by means of double throw lever switches. The machine starts freely and easily without sparking and without drawing more than full load current from the line.

The apparatus in the substation, the location and arrangement of same, the width and dimensions are in general as proposed for the substations to be built within the electric zone at the New York City terminal, so that practical experience with the plant may be obtained while the locomotive tests are being made and in advance of the construction of these stations.

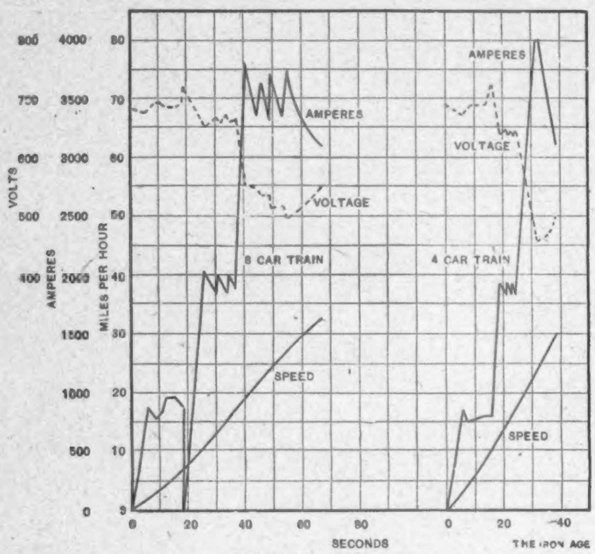
This power station, transmission line, substation equipment and 6 miles of track is undoubtedly the most complete testing plant ever provided for a trial of electric railroad motive power, and with the facilities afforded in addition to testing the new locomotives much interesting and valuable electric railroad information will unquestionably be obtained.

Owing to the fact that only a portion of the track to be used for testing is available as yet, no complete locomotive tests have been made. A full set of recording instruments has been installed in the cab of the locomotive, and records have been obtained of some of the preliminary runs made to test the bearings and running qualities of the locomotive. Although these records will be superseded by careful tests made on the full length of track, bonded and with sufficient feeders supplied to minimize the drop, they indicate in a general way what may be expected of the locomotive running in regular service. Two of the diagrams show the speed, current input and voltage at the locomotive all on a time basis, with an 8-car train weighing 336 tons, and a 4-car train weighing 170 tons, both exclusive of locomotive. The total weight of train, including locomotive and passengers, was 431 tons for the 8-car and 265 tons for the 4-car train.

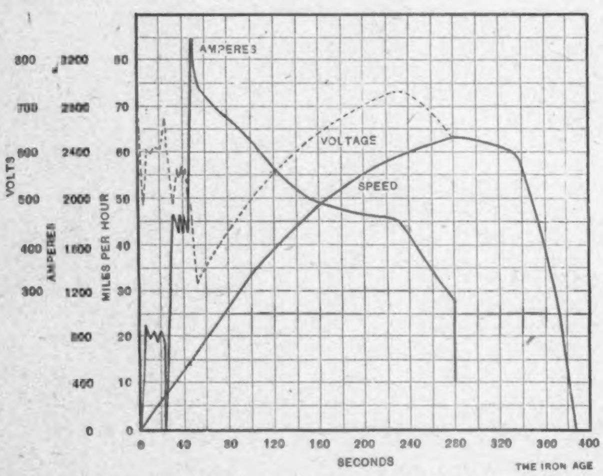
On these two running tests as high a maximum speed as possible was reached with the length of track available. The two sets of starting tests show the more rapid rate of acceleration possible with the higher maintained voltage available near

the substation. The maximum speeds reached were 63 m.p.h. with the 8-car train, and 72 m.p.h. with the 4-car train. It will be noted that the trains were still accelerating at these speeds, but the length of track so far equipped did not permit of attaining higher speeds. These locomotives are not designed for abnormally high speeds at intervals, but rather to obtain a high average schedule, due to their ability to accelerate more rapidly than is possible with the present steam locomotives.

In the starting tests a speed of 30 m.p.h. was reached in 60 seconds with an 8-car train, weighing, including the locomotive, 431 tons, corresponding to an acceleration of one-half mile per hour per second. During certain periods of the acceleration the increase in speed amounted to .6 miles per hour per second, calling for a tractive effort of approximately 27,000 lbs. This value was somewhat exceeded with the 4-car train, where a momentary input of 4,200 amperes developed a tractive effort of 31,000 lbs. with a coefficient of traction of 22.5 per cent. of the weight on drivers. The average rate of acceleration with the 4-car train, weighing, including the locomotive, 265 tons, was 30 miles in 37½ seconds, or .8 miles per hour per second, calling for an average tractive effort of 22,000 lbs.



STARTING TEST.

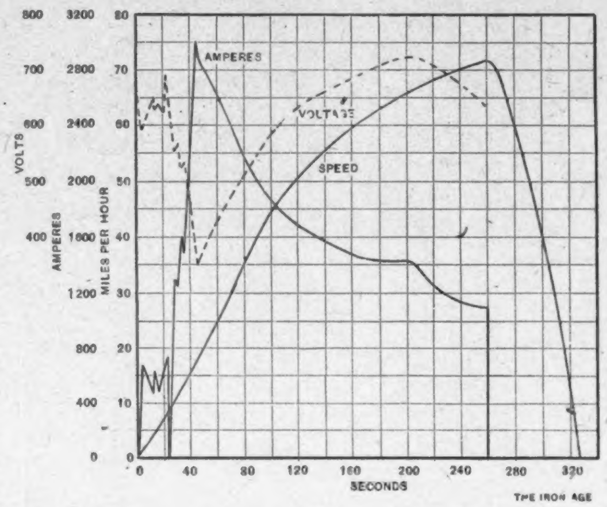


PRELIMINARY SPEED RUN NO. 1.—EIGHT-CAR TRAIN, 336 TONS; LOCOMOTIVE, 95 TONS; TOTAL, 431 TONS.

The maximum input recorded, 4,200 amperes at 460 volts, or 1,935 k.w., gives an output of the motors of 2,200 h. p. available at the wheel. With 4,200 amperes and a maintained potential of 600 volts there would have been an input to the locomotive of 2,520 k.w., corresponding to 2,870 h.p. output of the motors. This output is secured without in any way exceeding the safe commutation limit of the motors and with a coefficient of traction of only 22.5 per cent. of the weight upon the drivers, thus placing this electric locomotive in advance of any steam locomotive yet built. No service capacity temperature runs have been made as yet, and the preliminary tests have not shown any appreciable warming up of the motors.

Throughout both the starting and running tests the electric locomotive shows its remarkable steadiness in running, a distinct contrast in this respect to the steam locomotive, especially should the latter be forced to perform the work here shown to be accomplished by the electric locomotive.

The motor armatures are mounted fast to the driving axles and the elimination of gear and bearing losses permits of a very high efficiency of the locomotive. Reference to the motor characteristics shows a maximum efficiency of approximately 93 per cent., this value being fully 4 per cent. better than possible with motors of the geared type. This gain is especially noticeable at the high speeds, the efficiency curve remaining above 90 per cent. even at the free running speed of the locomotive alone, in contrast to the 85 per cent. or less which would be a good showing for a locomotive provided with geared motors. The simple construction and high efficiency made possible with this design of gearless motor, together with the minimum cost of repairs attending such a construction, makes the direct current gearless motor type of locomotive a distinct forward step in electric locomotive construction.



PRELIMINARY SPEED RUN NO. 2.—FOUR-CAR TRAIN, 170 TONS; LOCOMOTIVE, 95 TONS; TOTAL, 265 TONS.

CHARACTERISTIC CURVES—DIAMETER OF WHEELS, 44 INCHES; VOLTAGE, 600.

WHAT MOTIVE POWER OFFICERS ARE THINKING ABOUT.

EDITORIAL CORRESPONDENCE.

It is a pleasure to announce the Discovery of the Motive Power Department by a general manager of an important railroad. (The gentleman asked that his name be concealed, as almost everybody does when they have anything important to say). He has discovered that the mechanical department never had half a chance. He finds that in one of his shops the general foreman receives $150 per month for directing the labor of men whose pay roll amounts to $60,000. This man draws much less than any engineer in freight service, and yet the fine new shops for the operation of which he is responsible cost a half million. The manager has just discovered that a big roundhouse needs a man who is equal to any emergency, ready to cope with untellable difficulties and do unheard-of repairs with facilities no better than were provided under the conditions of the days of woodburners and engines weighing 60,000 lbs. One of his roundhouse foremen had fifty engines which he was trying to keep out of the shops and nearly an equal number of new ones fresh from the builders, all of which were expected to be in clockwork order during the past winter, when everybody fell down in trying to operate our railroads. It was last winter that the discovery was made, and the motive power department may live to see great benefits from that season of trial and grief. This general manager said that he did not understand how motive power superintendents got along at all, and he promises, for one, to "look into the matter and see what can be done."

What needs to be done is that which has long been done abroad—put the motive power department upon an independent basis, give the head of the department independent authority, allow him to build up his organization on a basis of efficiency, and then hold him responsible for results. He should have a salary instead of a remittance on account, and the position should be such that the best men cannot afford to step out because of superior attractions in other lines of activity. Not until this is done will American railroads have the benefit of the mechanical skill which they so greatly need.

It is encouraging to have a railroad president say (though editors have often said it) that the motive power problems of a great railroad system cannot be properly dealt with by any officer lower in grade and authority than a vice-president, reporting only to the president. "What we need," he said, "is a mechanical vice-president who has grown up in the motive power department." To hear such a remark is the crowning triumph of a good trip about the country. Where there is so much smoke there must be some fire.

The roundhouse has been a storm center, especially since the unusual congestion of traffic combined with the severe weather last winter. Many motive power men now find it easier to secure appropriations for improvements in handling locomotives at terminals, and the writer has seen several comprehensive and interesting plans for new roundhouses which are soon to be built. The mention of engine failures and roundhouse facilities brought instant response on a number of roads.

In one case, and it is to be hoped that there is only one such in the country, a strange lack of business capacity on the part of the operating department was revealed. After exacting a promise not to use his name, a superintendent of motive power stated that the division superintendents on his road made a practice of ordering engines when not needed, merely to keep one on hand for emergencies and "to keep it up to the master mechanics to have their engines ready—in other words, to keep the motive power department continuously in a hole." This gentleman showed me a telegram complaining because an engine was not ready which had not at the time arrived at the terminal. I have heard of such things, but never saw the evidence until now. A little intelligent co-operation would mean something to the stockholders of that road.

It is evident that the motive power department needs to be studied attentively by managing officers, who, as a rule, do not come into close enough contact with the motive power problems to understand them.

Apprenticeship is in as bad a condition as ever among the railroads visited. In two cases considerable interest was expressed in the subject, but it is incomprehensible that nothing is done. The railroads are paying dearly for neglecting apprentices. They will awake, but perhaps too late, to the facts. Subordinate officials may claim to be too busy to think about apprentices, but before long some one must have sufficient leisure to establish apprenticeship properly or all kinds of bad things will result, such as would naturally be expected from neglect of the system of recruiting the workmen of the future. Every year of delay will increase the difficulties of the next generation of managements as well as this generation.

An adequate apprenticeship system requires as a foundation a stable and businesslike official organization, with a well established policy which will take the future into consideration. The writer was asked whether anyone is doing anything to meet the apprentice problem, and he was obliged to say that he did not know of one railroad on which the problem is even fully understood.

It would be impossible to state the vital needs of the apprentices too strongly. The apprentice is the embryo shop man, and probably also the embryo officer, of the future. The educational aspects of his case constitute the vital question of the labor and organization problems of the future. Why should it be so neglected?

In connection with the World's Fair at St. Louis the Baldwin Locomotive Works are doing a nice thing for their apprentices. They are sent to the exhibit at the fair to stay three weeks, and two are changed every week. There are usually six there at a time. For two weeks the boys work about the exhibit and the other week they are left to themselves to visit the fair. All their expenses are paid, and on returning to Philadelphia each is required to write a report of something he saw. This plan is good for the boys and good for the firm. It is typical of the factors which bring the loyalty which is everywhere apparent among past or present employees of the Baldwin Works. The educational value to the boys is immense and the reports prepared by them are said to be very interesting.

At the St. Louis Exposition the writer ran across several groups of motive power men who were "doing" the exhibits together. In one case a superintendent of motive power had seven of his master mechanics with him and another had three. These people had arranged beforehand to meet the various exhibitors on certain days, and they got a lot more out of the exhibits than if they went independently and alone. The writer was invited to join one of these groups and found it remarkably helpful studying the various improvements. There seems to be a growing tendency toward "team work" on the railroads. A number of heads of departments are bringing up their subordinates to completely handle details, in order that the big business questions of the motive power problem may have appropriate attention. This tendency is marked and it is exceedingly important.

Five years ago, when this journal began a quiet campaign in favor of 4-cylinder balanced compounds, the railroad men were cold and would scarcely admit the subject into their conversations. Now all are watching them on the Pennsylvania and Santa Fe, the Burlington and the New York Central with intense interest and two roads wish to borrow one of these engines to investigate its merits. When the New York Central and the Pennsylvania engines are released from the World's Fair exhibits much more will be heard about them. The merits of this system of construction seem now to be so well established as to confirm the prediction of this journal that the 4-cylinder balanced compound principle will constitute the line of the immediate development of American practice.

Everybody is ready to talk about improving shop practice and everybody has improved records from certain machines, while some have remarkable results to show. One gentleman

said: "We are up against shop improvement in earnest. Wages are advancing. For instance, our boiler makers' rates have gone up an average of 17 per cent. in the past two years. Increased production of machinery and improved shop methods are necessary to enable us to hold our own against increased cost of labor. We must improve machinery and methods of doing work and handling material, but we do not find the support we ought to have in the form of appropriations for new machinery."

VAUCLAIN FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE.

4—6—0 TYPE.

NEW YORK, NEW HAVEN & HARTFORD RAILWAY.

The Baldwin Locomotive Works have built two of the 4-cylinder balanced compounds illustrated in the accompanying engraving in a lot of 20 passenger locomotives recently delivered to the New York, New Haven & Hartford Railroad. These locomotives are not heavy, in general appearance they resemble ordinary 4—6—0 construction, with the connecting rods coupled to the leading pair of drivers. Except as to the firebox and tender, these engines bear a strong resemblance

VAUCLAIN FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE—NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

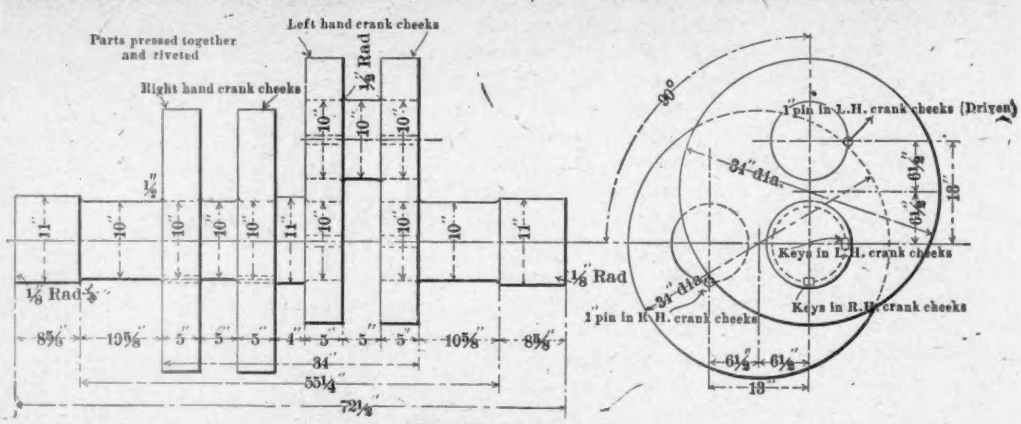
to the first balanced compound from these works, which was built for the Plant system and illustrated in this journal in March, 1902, page 72. The present engines have narrow fireboxes.

The introduction of the 4-cylinder balanced compound on this road is interesting because the present bridges limit the allowable weight on driving wheels and prevent the operation of such heavy locomotives as are really required to meet present conditions. It is significant of the value of this balanced type of construction that the eighteen simple engines of this order are limited to a weight of about 110,000 lbs. on driving wheels, whereas the balanced engines are allowed 123.000 lbs. In general features the two designs are very much alike, except as to the factors introduced into the two compounds by balancing.

The experience with these engines on this road will be watched with marked interest because of the fact that there seems to be something about the 4-cylinder balanced principle which leads to a remarkable duty in service, which cannot be entirely accounted for on theoretical grounds. The Burlington engine No. 2700, the report of tests of which is presented elsewhere in this issue, by its work justifies this statement.

In connection with these New Haven engines the built-up crank axle is interesting. These axles are made of the built-up type in order to insure the proper "working" of the material used in the cheeks and crank pins, which is believed cannot be properly secured in an axle of the forged type. These built-up axles are put together with a pressure of about 110 tons, and it is believed that in addition to the proper working of the metal, which can be secured in this construction, an additional safeguard is provided against fracture by providing an elasticity at the joints, which it may be expected to prevent failure by fracture. If a crank axle is to fail it is much better that it should become loose than to break. This step is in accord with recent locomotive practice abroad, where crank axles of large size are usually made of the built-up construction.

The dimensions of the compound locomotive are presented in the accompanying table.



BUILT-UP CRANK AXLE.

BALANCED COMPOUND PASSENGER LOCOMOTIVES.

4-6-2 TYPE N. Y., N. H. & H. R. R.

Gauge	4 ft. 8½ ins.
Cylinder	15 ins. and 25 ins. by 26 ins.
Valve	balanced piston
BOILER.	
Type	wagon top
Diameter	60 ins.
Thickness of sheets	9-16 ins., 11-16 ins., ⅝ ins.
Working pressure	200 lbs.
Fuel	soft coal
Staying	radial
FIRE BOX.	
Length	120⅜ ins.
Width	41½ ins.
Depth front	73 ins.
Depth back	62 ins.
Thickness of sheets, sides, ⅜ in., back, ⅝ in., crown, ⅜ in., tube, ½ in.	
WATER SPACE.	
Front	4 ins.
Sides	3 ins.
Back	3 ins.
TUBES.	
Material	iron
Wire gauge	No. 12
Number	318
Diameter	2 ins
Length	15 ft. 1 ins.

HEATING SURFACE.

Fire box	168.5 sq. ft.
Tubes	2497.5 sq. ft.
Total	2666 sq. ft.
Grate area	34.69 sq. ft.

DRIVING WHEELS.

Diameter of outside	72 ins.
Diameter of inside	66 ins.
Journals, main	10 ins. by 10½ ins.
Journals, others	8½ ins. by 12 ins.

ENGINE TRUCK WHEELS.

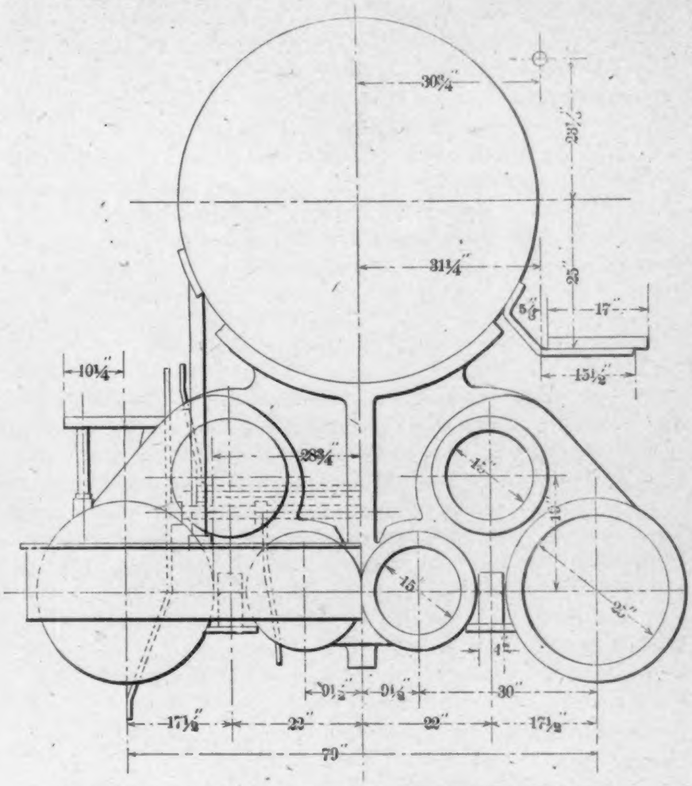
Front, diameter	33 ins.
Journals	5¼ ins. by 10 ins.

WHEEL BASE.

Driving	13 ft. 6 ins.
Rigid	13 ft. 6 ins.
Total engine	27 ft. 5 ins.
Total engine and tender	56 ft. 8 ins.

WEIGHT.

On driving wheels	123,100 lbs.
On truck, front	37,500 lbs.
Total engine	160,600 lbs.
Total engine and tender	about 270,000 lbs.



HALF-END VIEW AND SECTIONS THROUGH CYLINDERS.

TENDER.

Wheels No.	8
Wheels diameter	33 ins.
Journals	5 ins. by 9 ins.
Tank capacity	5,500 gals.

FIRE RISKS OF RAILROAD SHOPS.

Opinions of an Insurance Expert.

Whether railroad companies insure their shops themselves or with the insurance companies, the question of fire risks is always important. In many cases the only precaution, aside from providing hose reels in the buildings and hydrants in the yards, is the separation of the buildings by distances supposed to be sufficient to guard against a general conflagration in case one of the buildings takes fire. Automatic sprinkler systems are not used as generally in these shops as in other industrial establishments. Having this fact in mind, and also the popular impression that steel roof trusses will resist fire better than those of wood, the editor of this journal consulted Mr. John R. Freeman, widely known as an experienced expert on these questions. Mr. Freeman's statements are so explicit and so valuable as to commend themselves to our readers. He says:

I am a most hearty believer in slow-burning construction with timbers rather than steel trusses, and also a believer in the saw-tooth roof.

The result of our experience is a most earnest recommendation of complete sprinkler protection for substantially every building of a great railroad shop. Sprinkler protection is fourfold more effective in lessening the fire hazard than is a mere subdivision and isolation of the buildings without sprinkler protection.

In railroad shops, the woodworking and the painting must always remain extra-hazardous, and these departments should have isolated buildings. The interior of a box car, and especially the interior of a coach during the varnishing and finishing process, are extra hazardous and present so large an area shielded from the direct action of water from the sprinklers that is is conceivable that a fire within may obtain sufficient volume so that when it bursts out it will open a good many sprinklers, and make extraordinary demands on the water supply. I believe that the cases will be found extremely rare where sprinklers will not confine a fire of this kind to the car in which it originates, but causing very likely considerable smoke and water damage to the surrounding property.

The machine shop, smith shop, and the foundry must naturally be cut off from one another to insure freedom from dust and dirt, and so these buildings should be isolated or stand end to end and be cut off from one another by first-class fire walls.

For the main machine shop, there will seldom be occasion for one so large that it cannot remain a single area unobstructed by any partition. We, of course, realize that the more a large shop is subdivided by fire walls, the better insurance risk it becomes, but on the other hand, we recognize that absence of partitions favors low cost of production and we try not to stand in the way of the best economy.

We now insure one-story machine shops from 600 to 800 ft. in length, and from 100 to 200 ft. or more in width, without hesitation, and at a rate not materially higher than for smaller shops, providing the construction is first-class, and the sprinkler and hydrant system complete, and the net cost of this insurance in our companies for the past five years has averaged considerably less than 1-10 of 1 per cent. per annum, which you can easily figure out presupposes that the building and its contents will not be completely burned up as often as once in a thousand years.

We have come to make no distinction between buildings having their roofs supported by steel trusses and those supported by timber, although our experience demonstrates that the slow burning plank and timber construction will resist fire far better than any steel truss construction. We have found that with complete sprinkler protection, there is very little danger of the fire reaching such proportions that the trusses get heated to the warping or yielding point, but without sprinklers a brisk fire of 10 minutes' duration can completely warp a steel truss where a 12 x 16-in. Georgia pine beam 25 ft. in length could stand for an hour before it would yield.

Personally, I am a very strong advocate of the saw-tooth roof, and believe it well adapted to car shop work. Some care and skill are needed in working out the design to avoid condensation drip, and to avoid trouble from snow in northern latitudes, but it presents no unsolved problem, and will afford far better light than any roof of the monitor type, and is much easier to heat and much safer against fire than any steep lantern roof.

We may also look forward to the time, not far ahead, when recording instruments on the tools will give the superintendent a check on production and on the individual operator, that will enable him to keep track of the "personal equation" in the shape of lazy workmen in a most accurate and impartial manner, with corresponding benefits to the output of his tools, the dividends of the stockholders and the pay envelope of the diligent mechanic.—*F. B. Duncan, Franklin Institute.*

The largest all wood pulley ever built is on exhibition at the St. Louis Exposition. It is 20 ft. in diameter, has a 50-in. face and a 20-in. bore and is composed of over 11,000 pieces. It will transmit 1,500 h.p. and was made by the Reeves Pulley Company.

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Not one superintendent of motive power in this country has all of the facilities and equipment which he needs in order to keep up his locomotives and cars to their highest standard of efficiency. The railroads are waking up to the importance of improved machinery and improved methods, and we hope general managers will soon give unrestricted assistance in providing shop equipment which will permit of economical maintenance of rolling stock. This journal is alive to the need, and is endeavoring to assist motive power men by informing them of every important step in progress. It is only fair to ask for co-operation in an effort to help motive power men in their work. We ask a simple and easy thing, merely that the readers will mention this journal in asking for information concerning improvements in machine tools or other developments described in our pages.

The results of the preliminary tests of the New York Central & Hudson River Railroad electric locomotive, described on another page of this issue, are very gratifying. The General Electric Company and the American Locomotive Company, who designed and built it, have introduced some very radical changes in design from that of previous locomotives of this type which have greatly increased its efficiency. The quick acceleration, the easy riding at all speeds, the large, roomy cab, the absence of smoke and steam, and the fact that the engineer has a large, wide cab window, which enables him to see the full width of the track to within a few feet of the front of the locomotive, are qualities that forcibly impress one accustomed to riding a steam locomotive. With a greater length of track for the test and better bonding of the rails, it is reasonable to expect even a better showing than has thus far been made. The high efficiency of the locomotive over a wide range of speed is remarkable.

A manufacturer who had fitted up his shop with motor drives thought his power bills too large. He thought it due to wastefulness and took his men to task. The next power bill was some 40 per cent. less and he was pleased—until he discovered that the output of the shop was reduced correspondingly. He then wisely told the men that he wished large power bills, his reason being that the power was almost a direct measure of the output. He next bought recording watt meters and kept close watch of the power used in the different groups of machines, all of which led to a marked increase of output. Wattmeters might be used with great advantage in checking the work of departments and they should be more often used for this purpose.

Those who first applied individual motors to machine tools had very little information as to the amount of power required by the various tools and based their calculations on the size of belt used. But this method was not very satisfactory. Another method which was based on early experiments in motor driven tools and which gave fairly good results for machines on which either the work or the cutter rotated was to multiply the number of cubic inches of material removed per minute by a constant depending upon the material being machined. The formulæ given in an article in this issue are derived from actual practice and each type of machine is treated by itself. They are intended for preliminary estimates only.

The use of dull or poorly ground tools means that both time and power are being wasted and that a poor grade of work is being turned out. The purpose of the article on "Tool and Cutter Grinders," on another page of this issue, is to indicate certain types of grinding machines which it is essential to have in every well equipped railroad machine shop. This includes tool grinding and shaping machines for tools such as are used on lathes, planers, slotters and boring mills; universal tool and cutter grinders for milling machines, cutters of all kinds and such tools as reamers, counter-borers, etc.; and drill grinders adapted for sharpening both flat or twist drills. Self-contained motor driven emery wheels should be scattered through the shop, especially on the erecting side. These may be used to very great advantage for smoothing off castings or other kinds of work, in place of using a file, but should not be used to any great extent for sharpening tools, as this work should be concentrated in the tool room, where it can be handled by unskilled labor.

A record of a reduction of 56 per cent. in boiler-makers force, and a decrease of 80 per cent. in engine failures, accompanied by an increase of 6 per cent. in tonnage handled and a reduction of 4 per cent. in the number of locomotives required to do the work, is one which should bring the subject of water purification forcibly to the attention of managers and presidents. These results, as obtained on the Chicago & North Western, we describe on another page of this issue and no more forceful argument for liberal investments in water purifying plants can be required. Engine failures are becoming the subject of rigid investigation everywhere, and if no other advantage than their reduction is obtained the cost of the plants is fully justified. It is safe to say that the experience of this road may be repeated, and even in many cases surpassed, by other roads where the water is worse and the locomotives are of heavier types. This journal maintains that there is no plainer duty lying before railroad managements than the installation of apparatus for improving locomotive boiler feed water. In bad water districts nearly every boiler shop is overtaxed and men of the right sort to contend with the work are growing scarcer. Their wages are advancing, which constitutes another strong argument for a broad-minded business policy in this important matter.

It is a good plan to educate your successor so that when you are wanted for a higher position some one is ready to carry on your work. Taking this precaution indicates a broad-minded way of dealing with subordinates, and a man who prepares for promotion in this way usually receives it because his subordinates are helping him make his record. A young railroad officer, whose advancement is announced in this issue, is promoted largely because his whole outfit of subordinates were competent to carry on his work while he was called away temporarily for important special service. This is not merely good policy; it is an excellent business principle.

THE BEST LOCOMOTIVE.

Under this heading on another page of this issue a four-cylinder balanced compound locomotive is shown to provide the equivalent of 25 per cent. more boiler capacity than if it had simple cylinders with the same boiler. If a better record of the advantages of a compound over a simple locomotive has appeared in print the writer does not know it. A steam consumption of 22.86 lbs. per indicated horse-power per hour for a large modern locomotive is a remarkable result, and the Burlington tests are therefore specially noteworthy. The fact that the results come from the Aurora laboratory organization is a sufficient guarantee of their accuracy and trustworthiness.

These tests show nothing concerning the smoothness of working of the balanced compound or of its effect on the track. On another road the officials say that the saving in track repairs due to the use of the balanced compounds lead them to wish for no other than balanced engines.

To those who have expected much of the balanced compounds these tests and the opinions of the officials referred to are exceedingly gratifying.

A PREFACE IN SUPERHEATING.

It is significant that the Canadian Pacific, being the road on which the superheater was first applied to a locomotive in American practice, should be the first to take up the practice on a large scale. The reasons for this are stated in connection with a description, in this number, of new locomotives just completed for the Canadian Pacific, the statements being quoted as exactly as possible from the words of Mr. Vaughan. Thus far there seems to be no reason to believe that superheating will be anything but satisfactory; at all events, nothing of an unsatisfactory nature has thus far developed on that road. The table of figures, taken from performance sheets, is not entirely satisfactory as measure of the value of superheating, but it certainly justifies the step taken by the Canadian Pacific. The enginemen like these engines, and the firemen at once noticed a reduction in the amount of coal required. This indicates the possibilities for increasing the capacity of present locomotives, and because superheaters are easily applied to old as well as new locomotives, this principle seems to be one of very great importance. It will mean much to the railroads of this country if many engines which are deficient in boiler capacity may, by the addition of the superheater, be improved in effectiveness from 25 to 30 per cent. If the promises of the present are fulfilled, this will place in the hands of motive power officials that which they have long wanted, a means for improving existing locomotives as well as new ones, rendering them capable of dealing with conditions which have far outstripped their capacity. The decision of the Canadian Pacific may therefore be considered a most important one, and it is likely to mark a new epoch in American locomotive practice which no railroad official can afford to ignore. The beauty of the superheater is that, while revolutionizing in results, it is very simple mechanically; its use involves no radical changes in practice except, perhaps, in lubrication, and in this all will agree a revolutionary improvement is required for ordinary engines.

BOILER REPAIRS WITH TREATED WATER.

RECORDS FROM CHICAGO & NORTH WESTERN RAILWAY.

The results in a reduction of boiler repairs and failures due to flue leakage which are being obtained through the introduction of water treating plants are now becoming available after two or more years of service. The Chicago & North Western has installed a sufficient number of plants to supply good water to the locomotives running into Clinton and Boone, Iowa, and Mr. Robert Quayle, superintendent of motive power, has courteously granted permission for the publication of a report by Mr. F. G. Benjamin, master mechanic at Clinton, which contains valuable information of the sort that is greatly needed. This record does not represent all the advantages to be had from the treating plants, because about 15 per cent. of the locomotives had not been through the shops for general repairs during the period covered by the report, and these boilers have never been freed entirely from scale to give the treated water a perfectly fair chance. From the report the following is taken:

With reference to the reduction that has been made in the cost of operating locomotives in Iowa, due to the installation of water purifying plants, it is a little difficult to say exactly what reductions have been made because of other influences besides the purified water that may affect the decreased costs. The following figures, however, are submitted in testimony of the benefits derived from this purified water. The boilermaker force, for instance, has been decreased as follows: In 1902 there were at Clinton and Boone an average of 36 boilermakers, costing $10.40 an hour, and 42 boilermaker helpers, costing $7.09 per hour, while in 1903 and thus far in 1904 an average of 23 boilermakers at an average cost of $7.71 per hour and 35 boilermaker helpers at an average cost of $6.70 an hour have been sufficient. This means that the boilermaker force has decreased 56 per cent. and the cost for boilermakers has decreased 21.4 per cent. The larger percentage of the men being boilermakers and the increased compensation received by boilermakers makes the difference in the percentage of force employed and the cost of the labor.

This is not the only result, however, that has been produced, as the decreased number of boilermakers with the beneficial results from the treated water together have permitted the engines to be kept in such condition that the number of engine failures has dropped off to a remarkable degree. Below is a comparison of the failures due to leaky conditions in 1902 and 1903:

	1902.	1903.
Leaky flues	463	330
Leaky fireboxes	31	26
Leaky arch tubes	6	2
Total	500	358

From this it will be seen that the failures on account of leaky flues in 1903 over 1902 was reduced 30 per cent.

The greatest benefits, however, from treated water did not seem to be reached until along in August, 1903, and a comparison of the results from August, 1902, to and including June, 1903, and August, 1903, to and including June, 1904, shows the following very gratifying results:

	Aug., 1902, to and including June, 1903.	Aug., 1903, to and including June, 1904.
Leaky flues	544	99
Leaky fireboxes	33	20
Leaky arch tubes	6	1
Total	583	120

This gives us a reduction of 80 per cent. in failures due to leaky conditions in these months. These improved results in engine failures in 1903 over 1902 have been made with conditions that show a heavier ton mileage in 1903 than in 1902, showing that the engines were worked up to their full capacity and even under these conditions, made such an improvement.

The total ton mileage for 1902 was 2,934,130,377 ton miles and this tonnage was handled at a cost of 28.7 lbs. of coal per

100 ton miles. In 1903 the total was 3,154,484,507 ton miles at a cost of 27.5 lbs. of coal. From this it will be seen that an increase of 6.6 per cent. in ton mileage was handled during the year 1903 over the previous year, and that this work has been done with an average assignment of 159 engines in 1902, as compared with an average assignment of 154 engines in 1903, a saving of 4 per cent. in the number of engines. In each of the years, 83 per cent. of the engines assigned were in constant service.

From the above figures it will be seen that the boilermaker force was reduced 56 per cent.; the cost of boilermakers 21.4 per cent.; engine failures decreased 80 per cent.; an increased tonnage of 6.6 per cent. was handled, and the number of engines in service decreased 4 per cent.

It is rather difficult to say to what extent the cost for material and labor has been affected by this item, but it is safe to say that a very material decrease has been affected in this direction, as engines are being taken into the shops right along which required flues reset and new side sheets, where now repairs to machinery and resetting a portion of the flues is sufficient, thereby placing the engines in serviceable condition for from six to eight additional months before it is necessary to do the work that formerly would have to be done on the engines when first taken in under previous conditions.

There are a number of things that can be mentioned in connection with this as being beneficial, but which cannot be computed in dollars and cents, among which may be enumerated the benefits derived as follows: First, from the short time required for engines to go over the road, due to less engine failurés and delays on account of leaking; second, a better tone and feeling among our men, which necessarily means better service; third, longer time at terminals, which means more time to work on engines, consequently the engines are in better condition; fourth, less coal is consumed, other conditions being equal, because they are less hours on the road, and the destruction of the encrusting matter on the flues and firebox sheets means a higher evaporating power of the fuel consumed; fifth, there is less expense in the cost of delay and overtime because of the shorter time the engines will have necessarily been on the road; sixth, relief engines are not sent out to protect important passenger and mail trains, or to protect trains on stock nights, as was formerly necessary.

All of these things cannot be stated in cost in dollars and cents, but they all count for economy and better results.

PLANT OF THE LOCOMOTIVE & MACHINE COMPANY OF MONTREAL.

The American Locomotive Company has recently acquired the plant of the Locomotive & Machine Company of Montreal, Canada. This Montreal plant is operated under its original corporate name (The Locomotive & Machine Company of Montreal, Limited); there is a local manager and staff at the works, and a city office at Montreal, while the general offices are located at New York.

The plant is located some 6 miles to the eastward of the heart of the city of Montreal, being actually in the Parish of Longue Pointe, Quebec. The plot, covering 63 acres, extends from the St. Lawrence River on the south, to the right of way of the Great Northern Railway and the Montreal Terminal Railway at the north. The plant is provided with a complete system of tracks, connecting the various buildings with the two railways mentioned, and through them to all the lines which radiate from Montreal. The Government is constructing a dock and basin on the river front, from which water shipments may be made, and at which supply materials may be received.

LOCOMOTIVE & MACHINE COMPANY OF MONTREAL.
VIEW OF MACHINE SHOP AND OFFICE BUILDING.

The plant is seen to comprise a main building (including 5 principal departments), a power plant, a carpenter and pattern shop, a pattern storehouse, a structural shop and a scrap house. It is the most compact locomotive building plant in America, the arrangement of the several departments of the main building securing the free interchange of material and minimum distances to be traversed.

The main building includes a machine shop 132 ft. x 420 ft., also a forge and smith shop and erecting shop, a boiler shop and a foundry, each 66 ft. x 380 ft. The machine shop is divided into two bays by a central line of columns. Electric traveling cranes are provided as follows: Machine shop, 4, 10-ton; erecting shop, 2, 60-ton; boiler shop, 1, 20-ton; foundry, 2, 15-ton. In adition to these there are in the riveting tower of the boiler shop 2, 20-ton and 1, 10-ton hydraulic traveling cranes. All departments are provided with ordinary swing cranes; the provision of cranes of this class being extremely liberal.

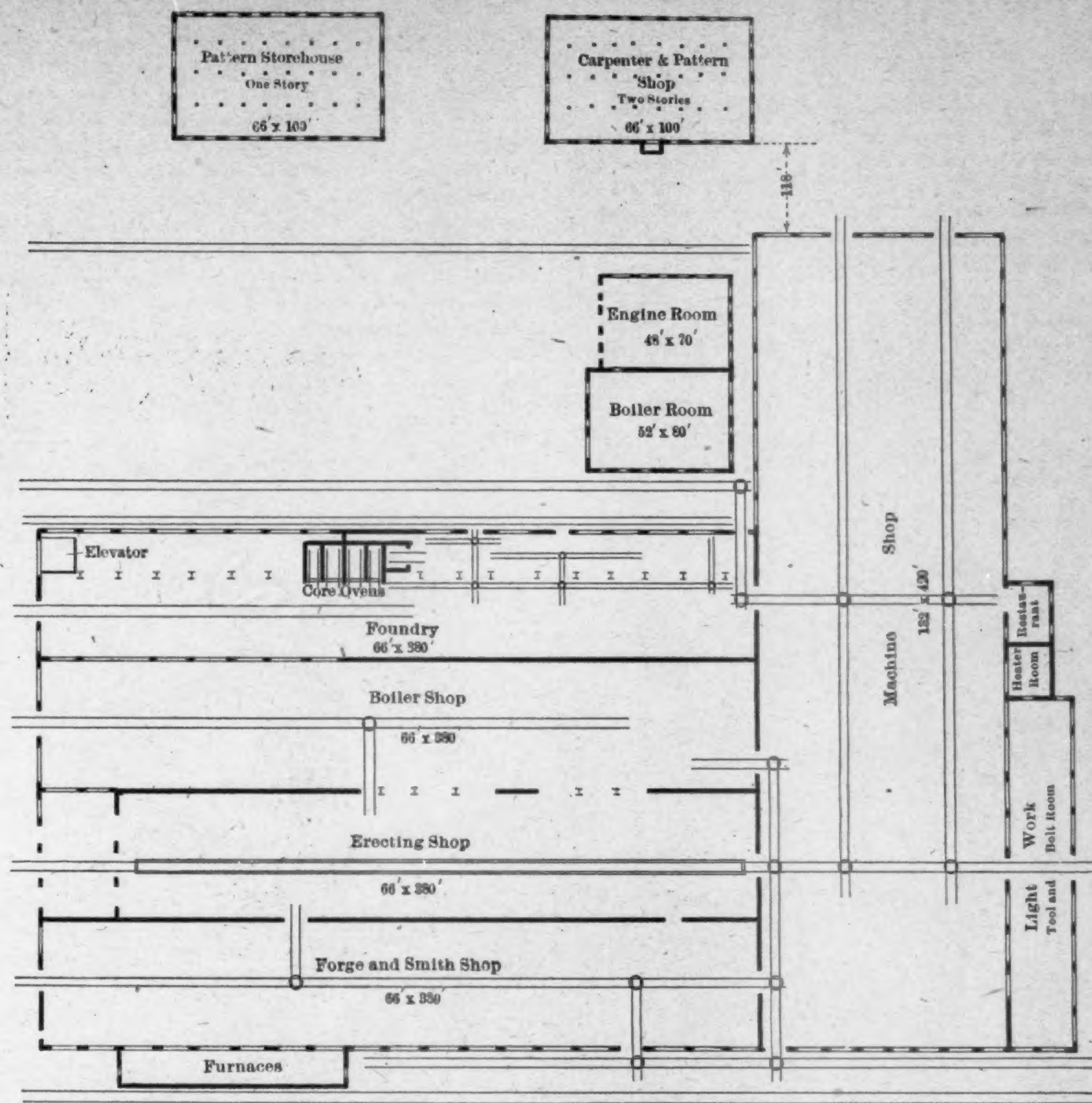
The pattern and carpenter shop is 66 ft. x 100 ft. and is of two stories. The pattern storehouse, adjacent to this building, is of the same size, but of one story. A storehouse and office building is located at the southwest corner of the main building.

There is also a large structural shop, 200 ft. x 300 ft., with but two posts within the entire floor area. Conditions existing in Canada justified the expectation that a structural shop, operated in connection with this locomotive building plant would be a profitable enterprise. It is especially designed and perfectly adapted to general structural work, either the building of bridges or trusses, steel work, etc., for steel buildings, and a great deal of work of this character has already been done and is now under way.

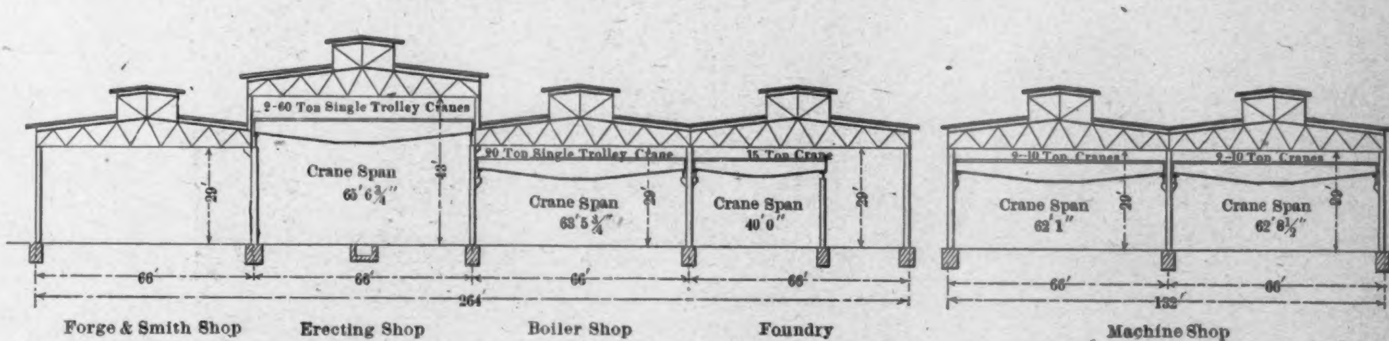
The buildings are thoroughly modern; the outer walls being of stone up to the window sill line and above that of brick. The roof trusses are of steel throughout. Many of the interior partitions are formed by studding, supporting expanded metal sheets and surfaced with plaster on both sides. Such partitions serve every purpose in the way of dividing the different departments, and are also cheap to construct and occupy a minimum of floor space.

The tool equipment of the plant was very carefully selected and is modern throughout. It is being amplified and enlarged, and a very liberal policy is in force, under which new tools or appliances which facilitate work or accelerate output are always installed as soon as their merits have become known.

The exterior appearance of the buildings of this plant shows them to be substantial and generally pleasing, but without any unnecessary ornamentation. A photographic view of the main building from the southwest shows the character of the buildings.



GROUND PLAN SHOWING COMPACT ARRANGEMENT OF BUILDINGS.



LOCOMOTIVE & MACHINE COMPANY OF MONTREAL CROSS SECTIONS OF SHOPS.

As regards output, it may be said that under present conditions, the works may be expected to turn out about 150 locomotives per year; with the additional tool equipment which has been ordered, and with the improved methods and organization which are being perfected, this output can be advanced to about 175 locomotives per year, when the force is on day work only, or to about 200 locomotives per year when working overtime. The boiler shop has a capacity in excess of the other departments, and can probably turn out about 300 boilers per year, but this excess capacity can be used to good advantage, as many railways order new boilers to replace the boilers of old locomotives which they modernize.

The company is building a large hotel and a number of cottages to accommodate many of the skilled workmen. These will be located on the company's land near the St. Lawrence River.

In our opinion, there never will be any pronounced improvements in steel car painting and maintenance until ways and means are devised to remove the flash scale always adhering to all new, common rolled steel plate; that, regardless of all adverse claims, all flash scale, hard or soft, should be removed, from the fact that when a coated over flash scale comes in contact with moisture through abrasion, it rots away from between paint coating and true under metal and falls off in large flakes, regardless of applied paint, in quantity or quality. On the question of possible improvements, we would recommend that the sand blast method be used to remove all scale from steel car structural plate; that it also be used by the manufacturing concern in original painting; that it also be used in railway repair yards as a matter of labor saving and economy.—*W. O. Quest, Master Car and Locomotive Painters' Association.*

TOOL AND CUTTER GRINDERS.

Improved tool and cutter grinders are rapidly coming into general use in railroad machine shops. With the advent of the high-speed tool steels attention has been forcibly directed to the importance of having the tools accurately ground to suit the class of work upon which they are to be used and of having them kept sharp and in good condition. The old system of having the high-priced machine hand let his machine stand idle while he sharpened his tools by hand and shaped them according to his own judgment, is fast being superseded by a new system of placing in the tool room tool grinding and shaping machines so designed that they can be operated by unskilled labor and will quickly and accurately grind the tools to the proper shape. As the various types of milling machines have been developed and come into more general use, a demand has been created for improved universal grinders to sharpen the various cutters used by them. With the introduction of the individual motor drive for machine tools there has been a demand for self-contained motor-driven emery grinders. The purpose of this article is to present some of the best types of these grinding machines, and by a few illustrations in each case to convey an idea of the wide range of work for which they are adapted.

Fig. 1 illustrates a William Sellers & Company No. 1 universal tool-grinding and shaping machine adapted for tools with shanks not over 2½ x 2 ins. The wheel has two conical grinding surfaces forming a V, with 90 degrees included angle, for convenience in grinding the different faces of tools, for increasing the available grinding surface, and to enable small and delicate splining tools to be ground. The tool-chuck can be rotated about a horizontal axis parallel with the shank of the tool, and can be readily set to any angle by means of a graduated circle and vernier reading to 1-10 degree. It is carried in a frame which can be rotated about a vertical axis passing near the point of the tool, and can be set to 1-10 degree. The frame is carried by two slide-rests at right angles to each other and moving parallel to the tangent planes of the two grinding surfaces. The slide-rests, frame and chuck are all carried by a vertical slide having a long square bearing accurately fitted, and the weight of the moving parts is counterbalanced by a spiral spring, so that, although massive and rigid, it can be reciprocated vertically with surprising ease. The chuck for grinding curved surfaces is inserted in the regular tool-chuck, and a frame carrying a gauge and a roller against which the former-plates work, is put in place in about half a minute. Means are provided by which a tool filed or ground to any desired curved shape can be used as a guide or templet from which a former-plate can be ground in the machine and afterwards used to exactly reproduce the tool or a curve parallel to it. A chuck is provided for grinding the side or base of a tool shank. Also a chuck by which a tool bent at a right angle can be ground the same as a straight tool without changing its position in the chuck.

The tool holder is capable of presenting the tool to the wheel in such a manner that any face can be so ground as to have a definite, predetermined relation to the other faces and to the shank, and the adjustment necessary to do this is simple and easily understood. The only shapes of cutting edges which cannot be ground on this machine are concave curves and re-entrant angles less than 90 degrees.

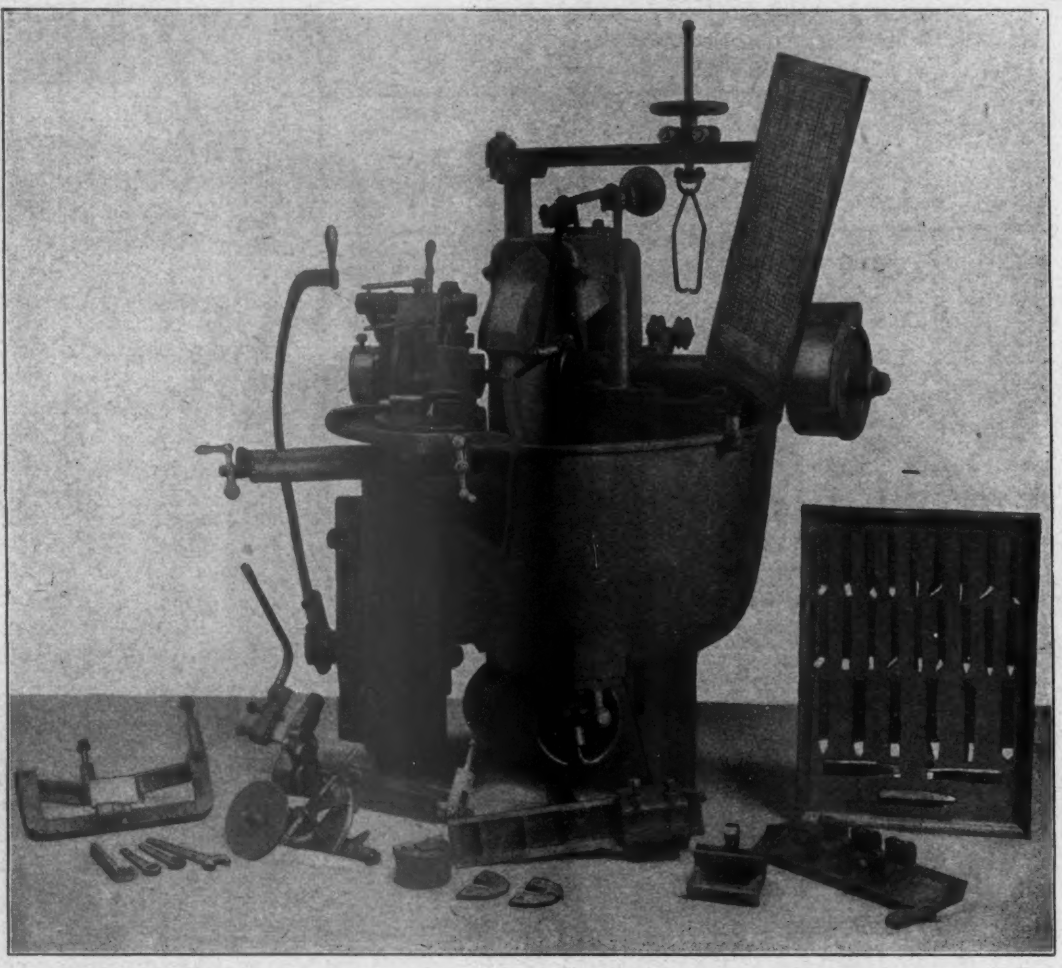


FIG. 1.—UNIVERSAL TOOL-GRINDING AND SHAPING MACHINE. WILLIAM SELLERS & COMPANY.

Fig. 2 illustrates the method of grinding a circular tool, Fig. 3 the application of a supplemental chuck as used for the outside face of an inside thread tool, Fig. 4 the grinding of the left side face of a large V tool and Fig. 5 an attachment for grinding boring cutters with correct and uniform clearance. These few applications will give some idea as to the wide range of work for which this machine is adapted. It is equipped with a crane for changing the wheel on its spindle and with a rotary pump for forcing water through a system of jointed pipes, ending in an adjustable nozzle. The working parts of the machine are protected from the water and the grit carried in it.

The importance of correctly grinding the lips of a drill can-

not be too strongly emphasized. Fig. 6 shows a patent improved drill grinding machine which is the result of a long and painstaking research made by William Sellers & Company. It is simple, can be operated by unskilled labor and will grind flat or twist drills from 5-16 in. to 3 ins. in diameter. The grinding of the lips is done on the face and not on the curved edge of the grinding wheel, which is in the form of a ring of emery firmly attached to a cast-iron back ring. The grinding wheel is protected by a cover, except where the drill comes in contact with it, and a centrifugal pump delivers the water in a gentle, abundant flow to the stone and drill without splash or waste. The ball handle F, operated by the left hand of the workman, rotates the drill back and forth in front of the grinding wheel in such a way as to insure the proper clearance. A device for pointing the drill is attached to the machine.

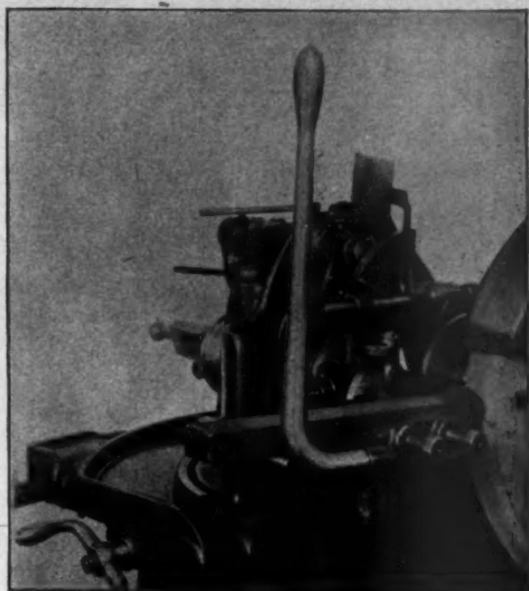


FIG. 2.—GRINDING A CIRCULAR TOOL.

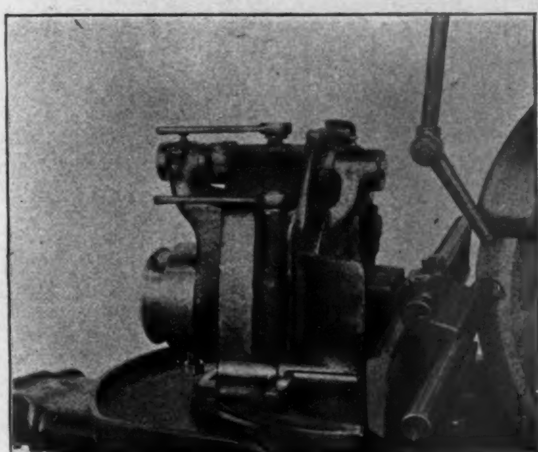


FIG. 3.—SUPPLEMENTAL CHUCK AS USED FOR THE OUTSIDE FACE OF AN INSIDE THREAD TOOL.

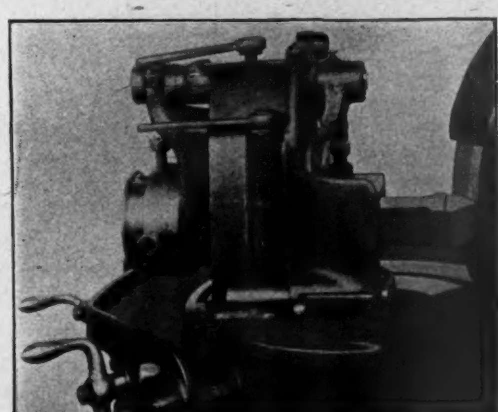


FIG. 4.—GRINDING THE LEFT SIDE FACE OF A LARGE V TOOL.

A universal tool and cutter grinder made by the Norton Emery Wheel Company, Worcester, Mass., and which takes 36 ins. between centers and has an 8-in. swing, is shown in Fig. 7. This machine is provided with attachments which can be easily and quickly adjusted for the various operations required in sharpening milling cutters, taps, countersinks, mills, etc. It is equally efficient for any cylindrical or conical work either on centers or on a chuck and for accurate sizing of internal work. It is provided with an automatic cross-feed arrangement for surface grinding.

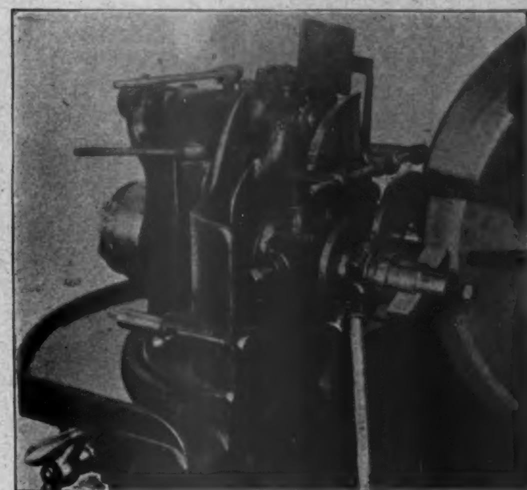


FIG. 5.—ATTACHMENT FOR GRINDING BORING CUTTERS WITH CORRECT AND UNIFORM CLEARANCE.

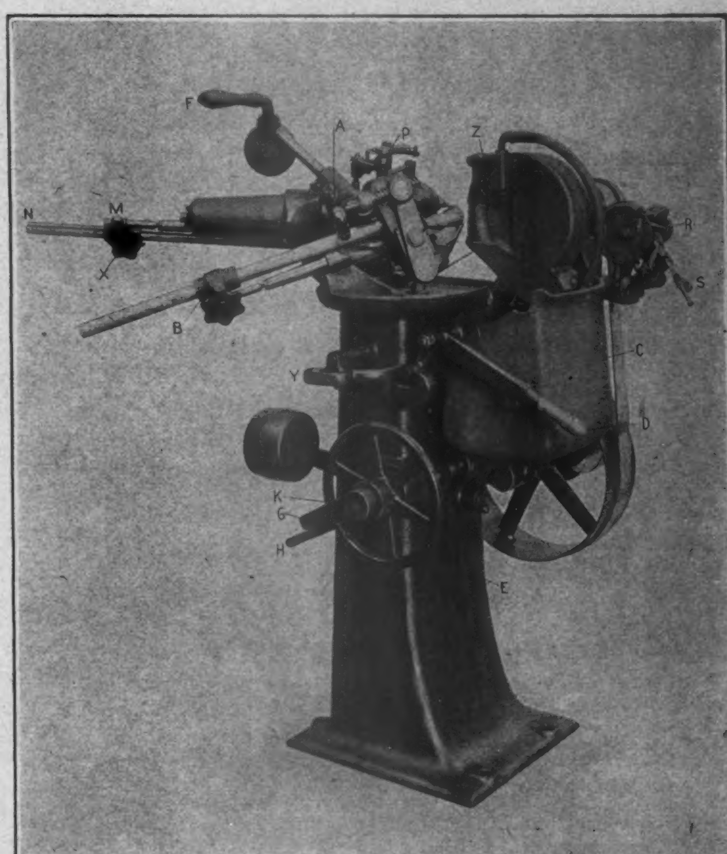


FIG. 6.—PATENT IMPROVED DRILL-GRINDING MACHINE—WILLIAM SELLERS & COMPANY.

Fig. 8 shows the method of sizing the taper shank of a cutter, Fig. 9 the method of sharpening a rose reamer, Fig. 10 the method of sharpening a small end mill and Fig. 11 shows the spindle and a piece of work adjusted ready for in-

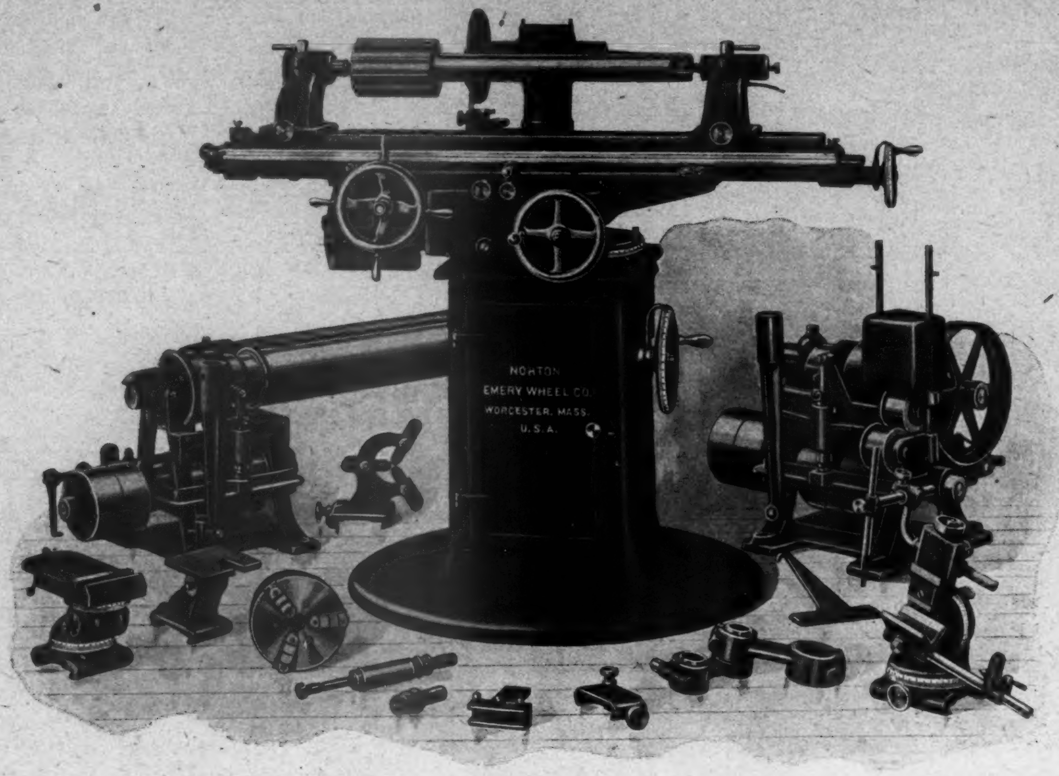


FIG. 7.—NO. 2 UNIVERSAL TOOL AND CUTTER GRINDER.
NORTON EMERY WHEEL COMPANY.

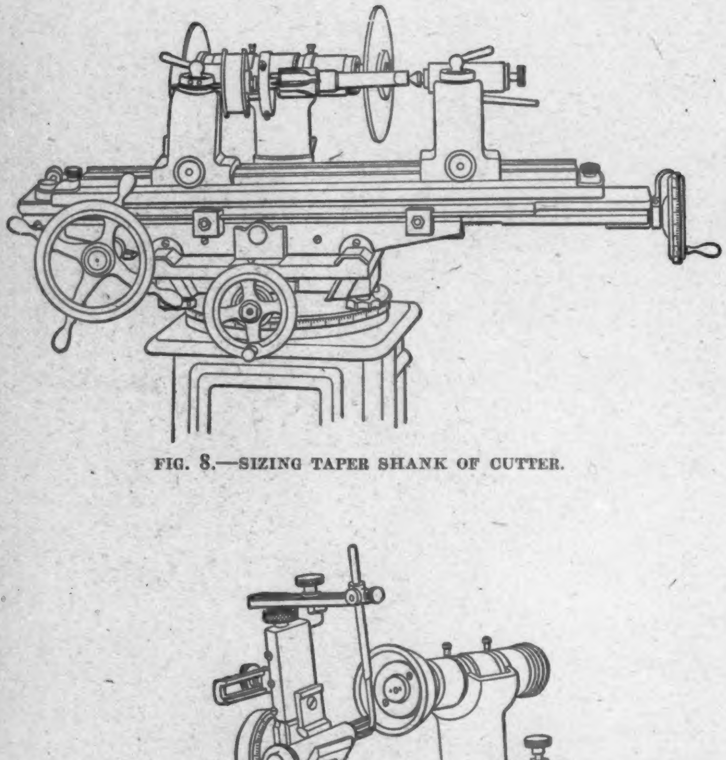


FIG. 8.—SIZING TAPER SHANK OF CUTTER.

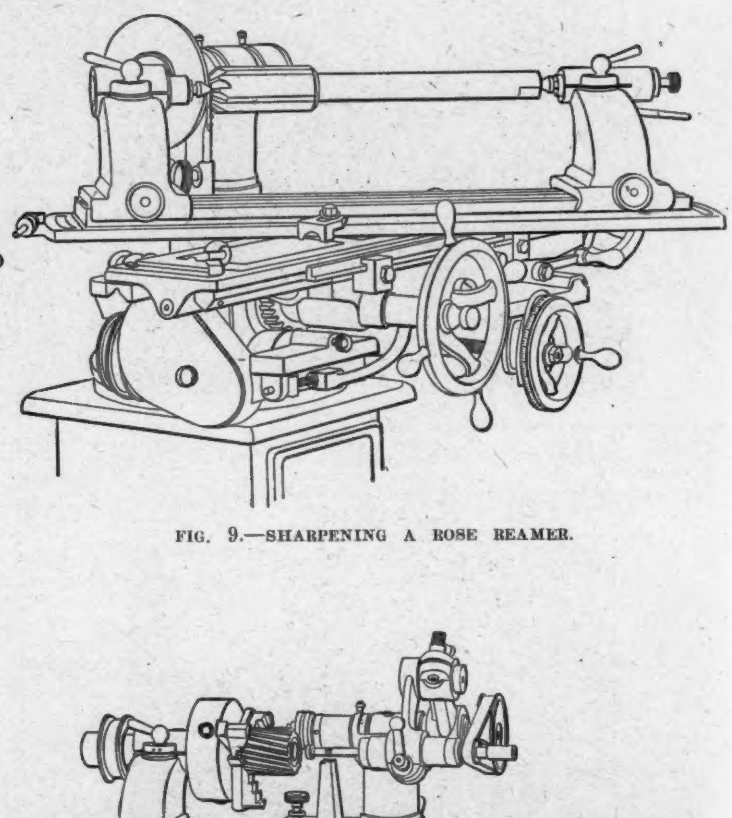


FIG. 9.—SHARPENING A ROSE REAMER.

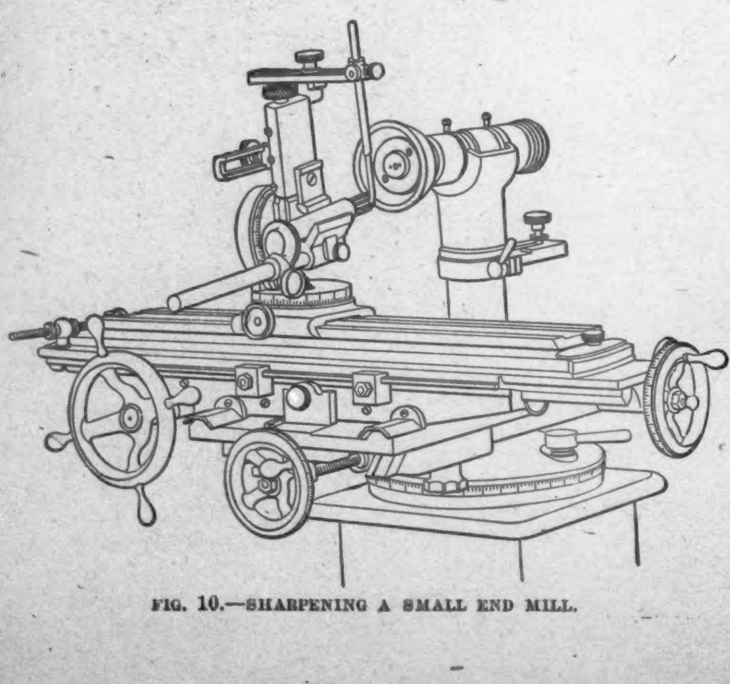


FIG. 10.—SHARPENING A SMALL END MILL.

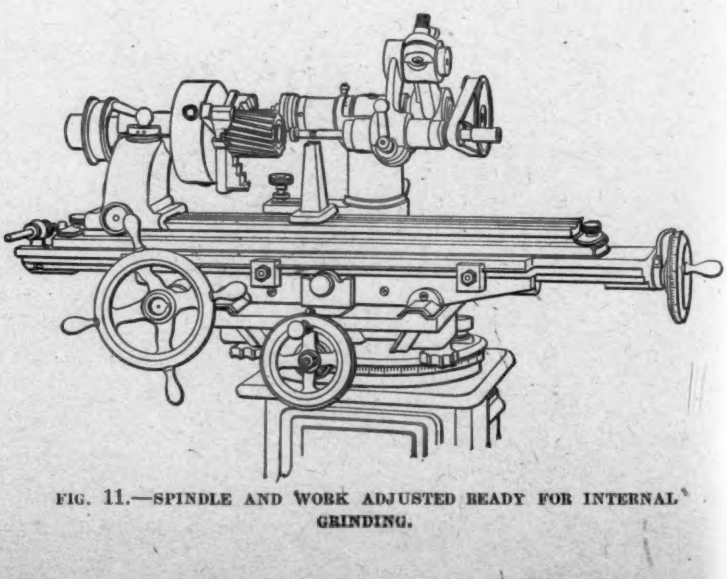


FIG. 11.—SPINDLE AND WORK ADJUSTED READY FOR INTERNAL GRINDING.

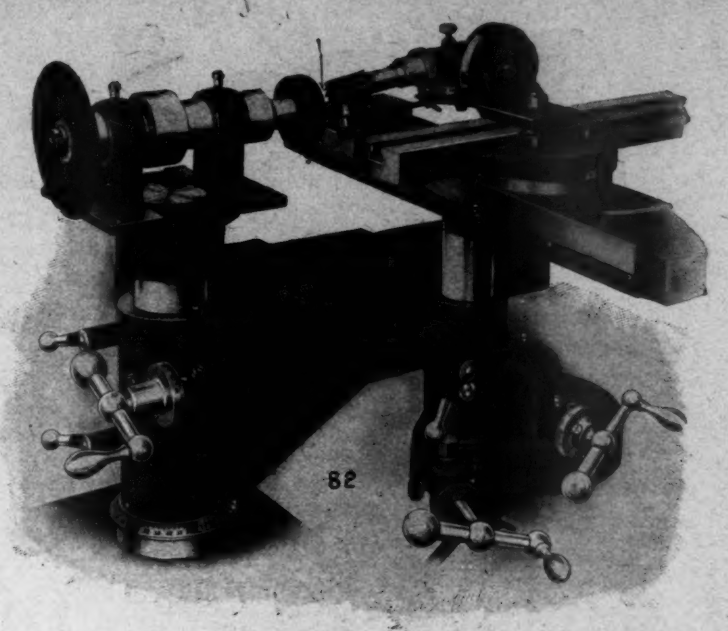


FIG. 13.—SHARPENING END TEETH OF AN END MILLING CUTTER.

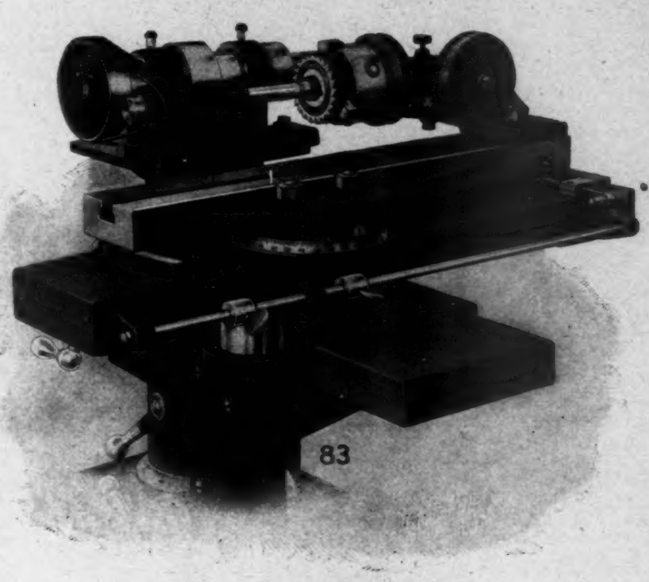


FIG. 14.—INTERNAL GRINDING.

FIG 12.—UNIVERSAL TOOL AND CUTTER GRINDER—CINCINNATI MILLING MACHINE COMPANY.

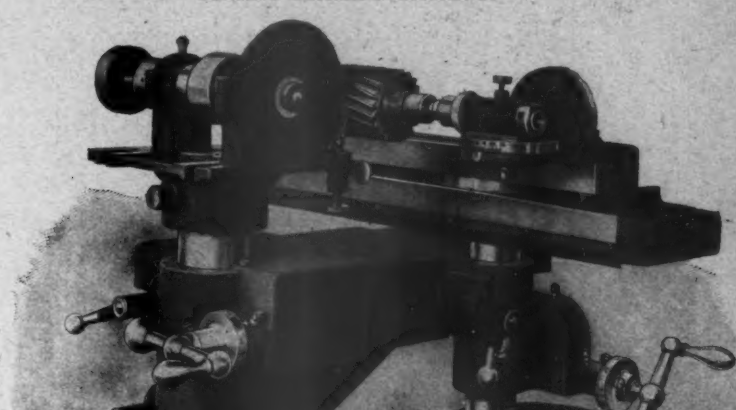


FIG. 15.—SHARPENING A SPIRAL MILL.

ternal grinding. These are but a few of the many varieties of work which can be done on this machine.

Fig. 12 shows a Cincinnati universal cutter and tool grinder made by the Cincinnati Milling Machine Company. It is also adapted for cylindrical, internal, face, surface and angular grinding. Fig. 13 illustrates the method of sharpening the end teeth of an end milling cutter, Fig. 14 shows an application of internal grinding, Fig. 15 the method of sharpening a spiral mill and Fig. 16 the method of sharpening a hand reamer.

A simple, self-contained motor-driven grinder, made by the Northern Electrical Manufacturing Company, Madison, Wis. is shown in Fig. 17. The starting and controlling mechanism is located in the pedestal. A variation in speed of 25 per cent is provided by the field rheostat. The motor is protected from dust, dirt and mechanical injury. In Fig. 18 the covers are shown transparent to illustrate the arrangement of the parts of the motor. Fig. 19 shows the wall type of Northern Electric Emery grinder arranged for grinding sprues in a foundry. The wheel at the right may be operated without a guard or rest, so that large pieces can be conveniently worked.

Fig. 20 illustrates the Milwaukee universal cutter and tool grinder manufactured by Kearney & Trecker of Milwaukee, Wis., and sold by Hill, Clarke & Company. A few of the many different kinds of work which can be handled on this machine are shown on Figs. 21 to 25 inclusive. These show the methods of sharpening a small end mill, an inserted tooth face mill, and a tap, and also illustrate the machine arranged for both internal and cylindrical grinding.

DO IT NOW.

"Do it now. Do not wait a lifetime before putting what seems to be a good thing into effect. Fix it up the best you can, and get the benefit of the improvement while you live and can watch the results, and perhaps you can improve upon them later." This is the rule of practice of a railroad official who has advanced rapidly, and is still advancing. By doing this he keeps his desk clear of detail and has time for the consideration of important problems.

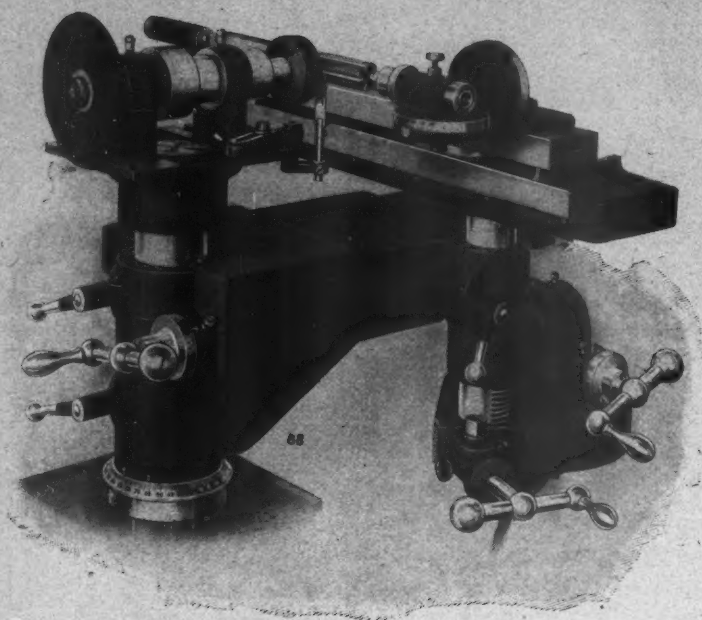


FIG. 16.—SHARPENING A HAND REAMER.

FIG. 17.—MOTOR-DRIVEN EMERY GRINDER—NORTHERN ELECTRIC MANUFACTURING COMPANY.

FIG. 18.—NORTHERN ELECTRIC EMERY GRINDER WITH TRANSPARENT COVER TO SHOW MOTOR.

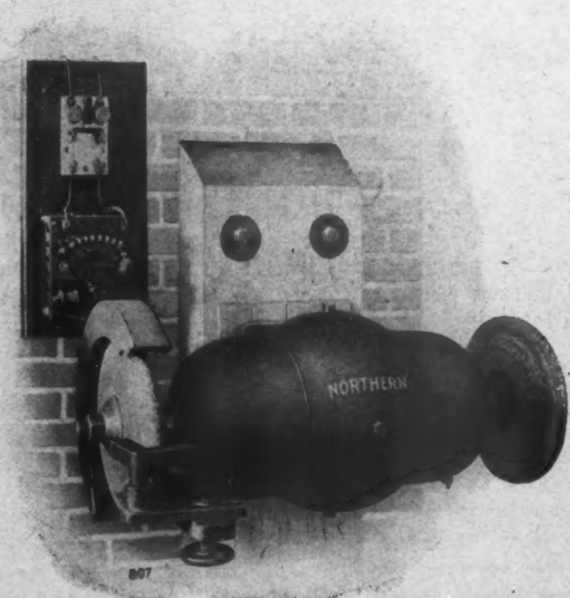


FIG. 19.—NORTHERN ELECTRIC EMERY GRINDER, WALL TYPE.

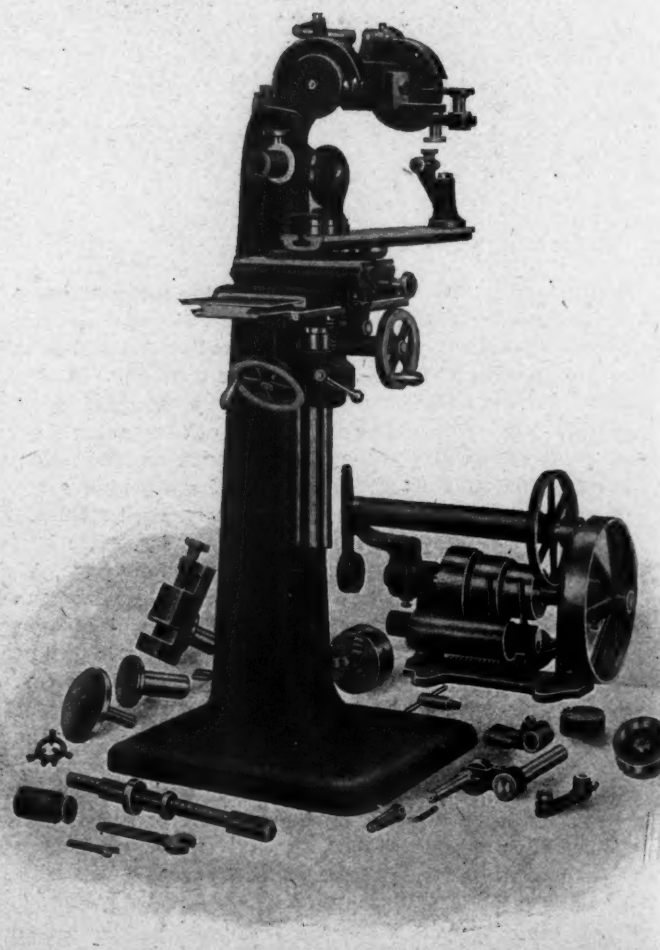


FIG. 20.—MILWAUKEE UNIVERSAL CUTTER AND TOOL GRINDER.

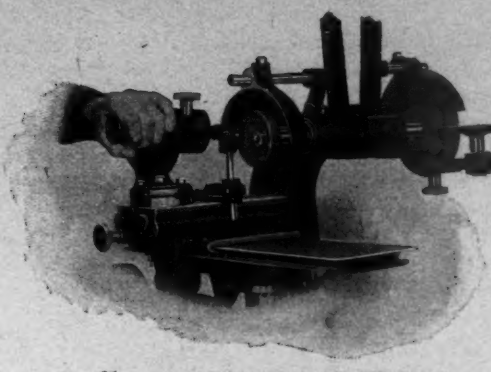


FIG. 21.—SHARPENING SMALL END MILL.

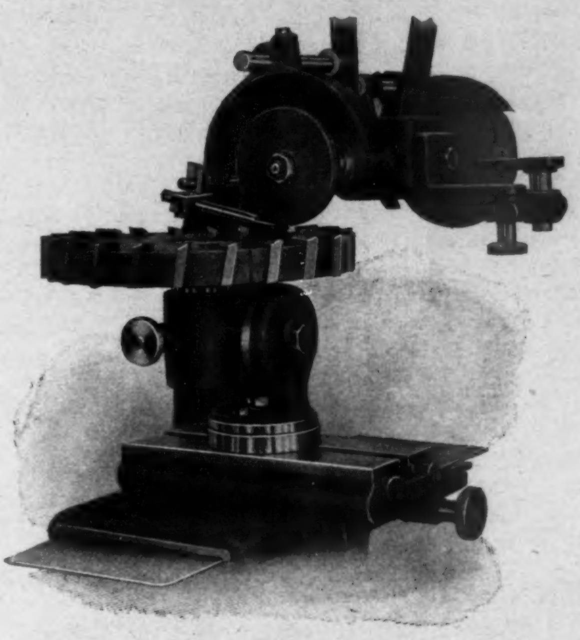


FIG. 22.—SHARPENING INSERTED TOOTH FACE MILL.

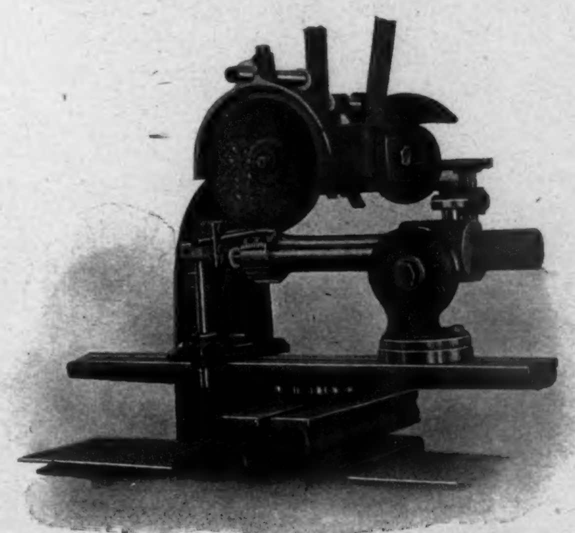


FIG. 23.—SHARPENING TAP.

The thermo-dynamic efficiency of all gas engines is now so much greater than any heat efficiency attained in steam engines that we can well afford to reduce economy, if need be, in order to make more certain of good practical results—that is, to make more certain of low cost for upkeep and repairs. In my view it would pay in large gas engines even to reduce fuel economy if by so doing entire immunity from breakdown was secured. So far the best means of limiting temperature in a simple way appears to be found in the addition of cooled exhaust gases to the charge before compression; and this method, although reducing flame temperature, has actually increased the efficiency instead of diminishing it.—*Mr. Dugald Clerk, British Association for Advancement of Science.*

THE NATIONAL MACHINE TOOL BUILDERS ASSOCIATION.

This association met in New York City November 15th and 16th. After discussing a number of important commercial questions the subject of motor application to machine tools occupied the most important position in the proceedings.

In view of the fact that about 25 per cent. of the product in lathes is arranged for electric operation, and considering that at present motor-driven lathes are not standardized, it is important that standardization of practice should be effected, which will permit of building direct-driven machines on the duplicate part system, which has been practised in building belt-driven lathes. This applies not only to lathes, but all sorts of machine tools. At present machines with direct motor applications cannot be built upon a manufacturing basis.

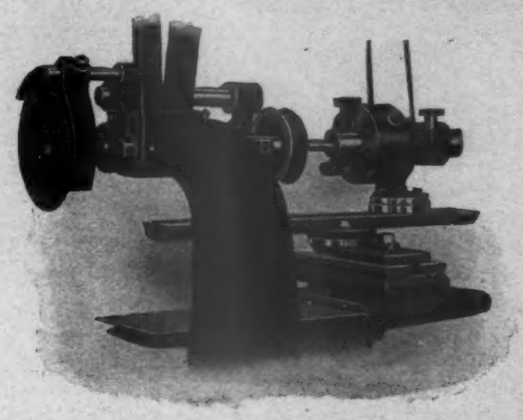


FIG. 24.—INTERNAL GRINDING.

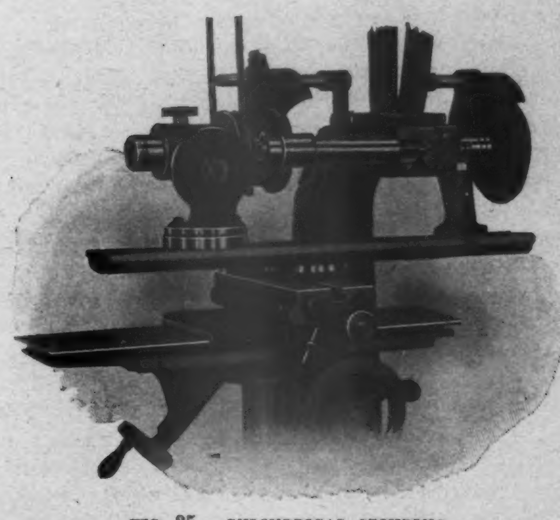


FIG. 25.—CYLINDRICAL GRINDING.

Mr. Fred A. Geier, secretary and treasurer of the Cincinnati Milling Machine Company, read an important paper, in which it was shown that the direct connected motor-driven machine tool has come to stay. He considered it necessary to decide upon a standard speed range of variable speed motors which would cover the entire field of machine tool driving, after which there will be no difficulty in bringing out a line of motors as a standard for machine tools. Because milling machines require a very wide range of speeds, he considered that a motor which was suited to milling would have sufficient range for any other machine. His company had found a 2½ to 1 variation satisfactory, with the standardized electric drive arrangement, for the milling machines built by them. He deplored the variety in shapes and sizes of motors which required special parts to suit the particular motor specified on every order. Mr. Geier suggested standardizing the size and shape of the base, the distance from the center of the driving pulley to the center of the base; the distance from the bottom of the base to the center of the armature shaft and the

diameter of the shaft. Two and a half, or at the most 3 to 1 variation, would be ample, and the maximum speed should be kept below 700 revolutions a minute.

Mr. W. H. Powell, of the Bullock Electric Manufacturing Company, followed with a paper in support of the same general argument. He discussed the various distribution systems and recommended a speed range of 3 to 1, with a minimum speed of 400 to 660 revolutions, dependent upon the output of the motor.

Mr. B. G. Fernald, of the Northern Electric Manufacturing Company; Mr. J. D. Maguire, President of the American Electric and Controller Company, and Mr. M. F. Reardon, of the General Electric Company, followed with remarks on the efforts which each of these companies is making in solving the question of motor drives.

The result of the discussion was the appointment of a committee, composed of Messrs. Woodward, Lodge, Geier, March, Tuechter, Binsee and Wetsel, to confer with motor manufacturers and submit recommendations as to standard mountings and dimensions.

The officers for the coming year are as follows: President, William Lodge; first vice-president, William P. Davis; second vice-president, F. E. Reed; secretary, P. E. Montanus; treasurer, Enoch Earle.

IMPRESSIONS OF FOREIGN RAILROAD PRACTICE.

EDITORIAL CORRESPONDENCE.

PARIS.

While it is necessary to make more than a brief visit to France to become sufficiently familiar with the locomotive practice there to put it on record with authority, a week spent in the study of French methods is sufficient foundation for the statement that they represent the most scientific treatment which is given anywhere to the locomotive to-day. For the past 19 years there has been a systematic and continuous effort to produce locomotives to meet the needs of French railways and the practice has crystallized into a type, for passenger service, which has been adopted by all of the important French railroads and it certainly is well adapted to France. This type began its development on the Northern Railway in 1885 when Mr. du Bousquet, of that road, consulted Mr. A. G. de Glehn, of the Societe Alsacienne de Constructions Mechaniques, concerning a method of increasing the capacity of a 4—4—0 engine without increasing its total weight. The history of this development has been written and need not be repeated here. It is sufficient to state that the co-operation of Mr. du Bousquet and Mr. de Glehn produced the type of locomotive widely known as the du Bousquet-de Glehn type. This construction has been most satisfactory and now no locomotives with separate tenders are being built of any other type for the French railroads. There is much that is interesting and instructive in the fact that instead of working in opposite and conflicting directions the locomotive superintendents of France saw the value of this construction. They were broad minded enough to lay aside personal prejudices and generous enough to adopt that which has proved itself to be the best to be had for their conditions. While France may be considered the home of the de Glehn compound its use has extended on the Continent and while it was developed originally for passenger service it is also extensively applied to freight service. Furthermore it has formed the basis for the work of other designers who have brought out four cylinder compounds, using a part but not the whole of the principle of the French engines.

There are no patents on the de Glehn construction and at present several builders are using the drawings which originated with such care at Mulhouse. This is an example which means much for the future of the locomotive in Europe. It is a case of a locomotive building concern producing, in connection with one of the leading railroads, a locomotive which was so much better than any in use in France as to lead to its general adoption to the exclusion of other types. It was developed from experience with two-cylinder and tandem compounds as well as simple locomotives and represents an effort to produce the best without undue regard to first cost of construction and without blindly worshiping simplicity. In France the coal question is exceedingly important. Coal is expensive and the best must be imported, the available supply of domestic coal being of poor quality. When the fine stuff is mixed with an adhesive substance and pressed into briquettes it makes an excellent fuel but is then more expensive than coal imported from England and Germany. The cost of coal in England, Germany and France explains the efforts put forth abroad to render the locomotives as economical as possible. In addition to the desire for greater economy there was another reason for approaching the design of a four-cylinder compound on the Northern Railway of France in 1885. Crank axles on the 4—4—0 simple engines of that road were breaking and it was evident that a division of the work among a larger number of parts was desirable. The first example of the new type was built for 11 kilograms pressure and weighed exactly the same as the simple engine and one ton lighter than a two-cylinder compound of the same date. The question of weight has always been important in France. This first four-cylinder compound is now running and remains to-day the most economical engine on the road. The next one was built in 1891, after five years experience with the first one. There are now about 1,800 engines of this type in service in Europe. The Great Western Railway of England has bought one of the latest type of those in use on the Northern Railway of France and one was built last winter (see AMERICAN ENGINEER, June, 1904) at Belfort for the Pennsylvania Railroad. The writer saw this engine during its construction and marveled at its beautiful design and workmanship.

After a careful but brief examination of the methods of designing these engines, which is always done under the personal direction of Mr. de Glehn; after studying the shop methods of construction at Belfort; after riding on the locomotives handling the fast trains on the Northern Railway and looking over many records of performance in the offices of the leading locomotive officials of France, the writer can not avoid the conclusion that the French railroads are supplied with locomotives which are better suited to their needs than are the railroads of any other country prominent in railroad progress. What these engines will do in England and in the United States will soon be known, and a great deal of valuable information may be expected from the tests of the Pennsylvania engine at St. Louis. Whatever may be learned of these engines out of France, American railroad managers, if they knew of their performances in France, would not delay in sending representatives to study them in their work at home.

English roads are up against a stone wall. They need more power without increasing size and weight. German roads are in very much the same condition. In the United States we have size and weight, but need to use these more scientifically in order to meet the exigencies of the present demands. Before trying something else, all should make sure that French practice does not supply the very thing that is necessary. The same sort of continuous, conscientious, broad-minded and consistent effort which justifies the writer in his enthusiasm concerning these French compounds must be applied in all of these countries before they will be even with France in the race for well adapted locomotives.

Locomotive development is also a development of men. Mr. de Glehn has personally superindended the design of every new type of locomotive built by his concern during the past 20 years. He has applied an experience which began in marine engine construction and he has been cordially assisted by the railroads. The railroads have learned that competitive passenger service cannot be satisfactorily conducted without good

locomotives, that locomotives must necessarily be more complicated if they are to do the work required of them and they have risen to the occasion with methods of handling and of caring for these locomotives which are as necessary as they are effective. In the United States we make all machines more complicated in order to increase power and to save manual labor. For example, note the present machinery for rolling steel shapes and also note what it does. Likewise note the equipment of a modern blast furnace, of the air brake, of railroad signals and kindred mechanical combinations. We have not complicated the locomotive but we must not hesitate to do so if it becomes necessary.

Locomotives cannot be improved unless the men in charge and those who handle them also improve. There must also be an improvement in the status of the locomotive departments and an advancement of the standing of the men at the head of these departments before the American locomotive will be what it should be. These notes are not to say that we may learn from foreigners what we should do. They are not to say that we should take any locomotive from any other country, but they are to say, and to say it emphatically, that American railroads are making a serious mistake in their treatment of the locomotive department as a whole, in making it subordinate and in placing the head of the department in a position which is inferior to that of an official of a commercial enterprise who has but one-tenth of the responsibility, who requires but one-twentieth of the experience and possesses even a smaller proportion of all around ability. We cannot do much when a large road has four superintendents of motive power in as many years, and when it is possible for many of the best men for these positions to be attracted away to other fields of effort. Our railroad managements need to take heed of the appreciation of locomotive officials in Europe. Our locomotive departments are facing difficulties in the management of men which are unknown abroad and it is earnestly hoped that these words will not prove entirely ineffective. It is not a matter of sentiment but pure business to put our motive power officials in position to do things and to surround themselves with organizations which will make their lives worth living while they do them. There must also be something softer than the frozen world for them to drop on, at the end, when they are worn out.

G. M. B.

(To be continued.)

POWERFUL PRAIRIE TYPE LOCOMOTIVE.

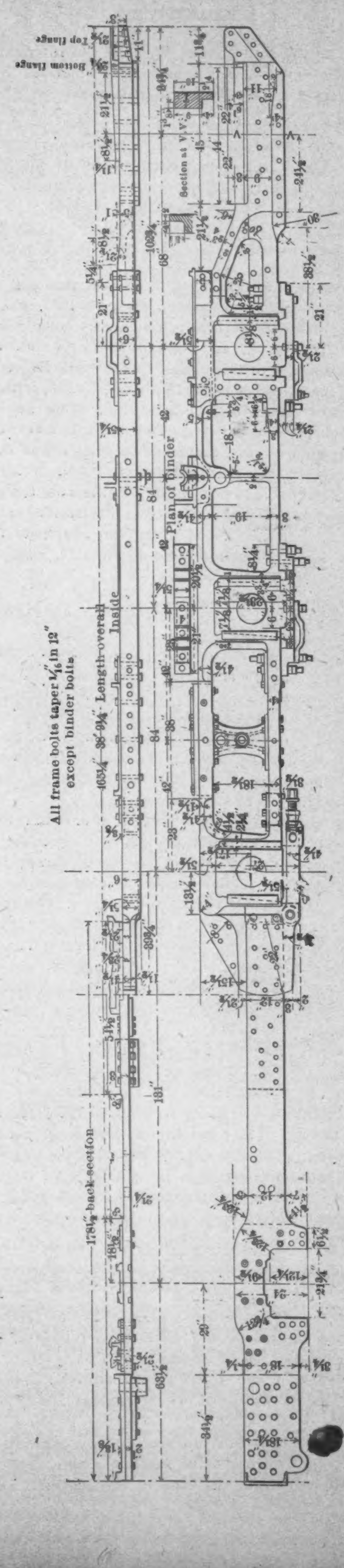
LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

On page 413 of our November number a description of the very powerful 2—6—2 type passenger locomotives of the Lake Shore & Michigan Southern was presented. Some of the details are now available.

These engines have cast steel frames, which are 6 ins. wide at their widest portion, as shown in the accompanying illustration. These frames are braced against twisting by cast steel bracing extending between the frames at the rear pedestal of the leading driving axle. They are braced again by a large flat steel casting on top of the frames between the second and third driving wheels and again at the slope of the frames over the splice in front of the throat sheet. This practice in frame bracing (AMERICAN ENGINEER, January, 1904, page 12) has proven very satisfactory in service. The pedestal binders are rectangular in section except those at the rear axle, which are adjustable.

The fireboxes of these engines are 6 ft. wide and the firemen handle them more satisfactorily than the Class J fireboxes, which are 7 ft. wide, indicating that a foot in width makes a material difference to the firemen, who prefer a firebox 6 ft. wide and 9 ft. long to one which is 7 ft. wide and 7 ft. long.

Other interesting details of these locomotives will be presented next month. Special attention has been directed to the frames because of the serious and general difficulty which has been experienced with frame breakage.



CAST STEEL FRAMES FOR NEW 2—6—2 TYPE PASSENGER LOCOMOTIVES.

LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY.

AGGREGATE TRACTIVE POWER OF AMERICAN LOCOMOTIVES.

According to the 16th annual report of the Interstate Commerce Commission, the total number of locomotives in service in this country June 30, 1903, and their capacities are as follows:

CONDENSED STATEMENT OF CLASSIFICATION OF LOCOMOTIVES.

Item.	Single expansion.		Four-cylinder compound.		Two-cylinder compound.	
	Total.	Average.	Total.	Average.	Total.	Average.
Number	40,443	......	1,953	......	849	......
Tractive power ....pounds	855,609,361	21,156	59,665,313	30,551	26,640,866	31,379
Grate surface ....square feet	1,088,007	27	96,704	50	31,092	37
Heating surface ....square feet	64,322,427	1,590	5,276,640	2,702	2,166,132	2,551
Weight, exclusive of tender ....tons	2,306,763	57	194,010	99	69,932	82
Weight of drivers ....tons	1,862,194	46	137,236	70	57,702	68

From the above statement it appears that the total number of single expansion locomotives on June 30, 1903, was 40,443, giving an aggregate of tractive power, measured in pounds, of 855,609,361. This gives an average of 21,156 lbs. tractive power per locomotive of this class. Of four-cylinder compound locomotives, there were on the date named 1,953, with an aggregate tractive power of 59,665,313 lbs., being an average of 30,551 lbs. per locomotive. The total number of two-cylinder compound or cross-compound locomotives on the same date was 849, with an aggregate tractive power of 26,640,866, or an average tractive power of 31,379. Estimating the average tractive power of the 626 locomotives unclassified at below those of single-expansion locomotives, the aggregate tractive power of the locomotives in service on June 30, 1903, may be safely estimated at 950,000,000 lbs.

A. C. ELECTRIC TRACTION FROM GAS POWER.

A somewhat unique departure from established methods in electric traction has recently been undertaken at Warren, Pa. The Warren & Jamestown Street Railway Company is equipping an A. C. single-phase electric railway system to operate between Warren, Pa., and Jamestown, N. Y., for which power will be supplied by gas engines operating upon natural gas. The equipment is now being constructed by the Westinghouse companies at East Pittsburg, Pa.

The power station will be located at Stoneham, Pa., two miles from Warren. The initial equipment will consist of two Westinghouse gas engines, each of 500 brake horse-power capacity. They will be of the horizontal single-crank double-acting type, direct connected to two 260 kw. Westinghouse generators, furnishing current at voltage sufficient for direct use upon the high tension transmission line. The power equipment also comprises a 55 h. p. Westinghouse gas engine for operating an air compressor and exciter unit. Natural gas will be used, which has a calorific value of about 1,000 b. t. u. per cu. ft.

Transformer sub-stations, five in number, will be located along the right of way. These will receive the high tension current from the transmission line and reduce the voltage to such an extent as to render it more suitable for use in single-phase motors. The present motive power equipment will comprise four quadruple sets of Westinghouse single-phase motors, each approximately 50 h. p. capacity. An interesting feature of the system is the arrangement for operating the alternating current motors upon the direct current trolley lines within the city limits of the termini.

RAPID LOCOMOTIVE CONSTRUCTION.

An interesting and important example of the possibilities of modern shop equipment and methods is furnished by the record of construction of 20 locomotives recently built at the Schenectady Works of the American Locomotive Company for the Canadian Pacific Railway. These engines are illustrated in this issue.

The contract was closed in Montreal under a guarantee that the first two engines were to be shipped within thirty days (Sundays included) from the date of the contract, and the balance at the rate of two each working day thereafter until the order was completed. This schedule was carried out exactly. The locomotive company had practically no material in stock, and it was necessary to order the principal items, which was done either by telephone or telegraph, on the day the contract was made. Special mention should be made of the boiler, firebox and tank plates, which were ordered from the Worth Brothers Company, Coatesville, Pa., by telephone on the day the contract was placed, the formal order, with details, reaching them the following day. All of the principal plates were shipped within five days from receipt of the formal order. The shops of the American Locomotive Company began work on the plates six days after the contract was placed, and the first boiler was in the erecting shop on the seventeenth day.

The patterns for the steel castings were in the Montreal shops of the locomotive company. These were sent by express the day after the contract was placed, arriving at the foundry of Pratt & Letchworth Company the next day, and were in the sand the same afternoon. The first shipment of steel castings, which included frames, wheel centers, etc., was made by Pratt & Letchworth Company six days after receipt of the patterns, and the entire order was completed by them in twelve days.

HIGH SPEED TOOL STEEL.

This article considers the treatment and use of high speed tool steel and is abstracted from a paper on "The Development and Use of High Speed Tool Steel," read by Mr. J. M. Gledhill before the Iron and Steel Institute.

What may be said to determine a high speed steel, as compared to an ordinary tool steel, is its capability of withstanding the higher temperatures produced by the greatly increased friction between the tool and the work due to the rapid cutting. An ordinary carbon steel containing, say, 1.20 per cent. carbon, when heated slightly above the critical point and rapidly cooled by quenching in water becomes intensely hard. Such a steel gradually loses this intense hardness as the temperature of friction reaches, say, 500 degrees F. With rapid cutting steels the temperature of friction may be greatly extended, even up to 1,100 to 1,200 degrees F., and it has been proved that the higher the temperature for hardening is raised above the critical point and then rapidly cooled, the higher will be the temperature of friction that the tool can withstand before sensibly losing its hardness.

In the heat treatment of high speed steel, one of the most important points is the process of thoroughly annealing it after working into bars. Accurate annealing is of much value in bringing the steel into a state of molecular uniformity, thereby removing internal strains that may have arisen, due to casting and tilting, and at the same time annealing renders the steel sufficiently soft to enable it to be machined into any desired form for turning tools, milling cutters, drills, taps, screwing dies, etc. Further advantage also results from careful annealing by minimizing risks of cracking when the steel has to be reheated for hardening. In cases of intricately shaped milling tools having sharp square bottom recesses, fine edges or delicate projections, and on which unequal expansion and contraction are liable to operate suddenly, annealing has a very beneficial effect toward reducing cracking to a minimum. Increased ductility is also imparted by annealing, and this is especially requisite in tools that have to encounter sudden shocks due to intermittent cutting.

In preparing high speed steel ready for use the process may be divided principally into three stages: Forging, hardening

and grinding. It is very desirable that high speed steel should be capable of attaining its maximum efficiency, and yet only require treatment of the simplest kind, so that an ordinarily skilled workman may easily deal with it. The steel may be raised to a yellow heat for forging, say, 1,850 degrees F., at which temperature it is soft and easily worked into any desired form, the forging proceeding until the temperature lowers to a good red heat, say, 1,500 degrees F., when work on it should cease and the steel be reheated.

In heating a bar of high speed steel preparatory to forging (which heating is best done in a clear coke fire) it is essential that the bar be heated thoroughly and uniformly, so as to insure that the heat has penetrated to the center of the bar, for if the bar is not uniformly heated, leaving the center comparatively cold and stiff, while the outside is hot, the steel will not draw or spread out equally, and cracking will probably result. A wise rule in heating is to "hasten slowly."

The temperature for hardening high speed steel varies somewhat according to the class of tool being dealt with. When hardening turning, planing or slotting tools, and others of similar class, the point or nose of tool only should be gradually raised to a white melting heat, though not necessarily melted, but even should the point of the tool become to some extent fused or melted no harm is done. The tool should then be immediately placed in an air blast and cooled down, after which it only requires grinding and is then ready for use.

Another method which may be described of preparing the tools is as follows: Forge the tools as before, and when quite cold grind to shape on a dry stone or dry emery wheel, an operation which may be done with the tool fixed in a rest and fed against the stone or emery wheel by a screw, no harm resulting from any heat developed at this stage. The tool then requires heating to a white heat, but just short of melting, and afterward completely cooling in the air blast. This method of first roughly grinding to shape also lends itself to cooling the tools in oil, which is specially efficient where the retention of a sharp edge is a desideratum, as in finishing tools, turret and automatic lathe tools, brass workers' tools, etc. In hardening where oil cooling is used the tools should be first raised to a white heat, but without melting, and then cooled down either by air blast or in the open to a bright red heat, say, 1,700 degrees F., when they should be instantly plunged into a bath of rape or whale oil, or a mixture of both.

Referring to the question of grinding tools, nothing has yet been found so good for high speed steels as the wet sandstone, and the tools ground thereon by hand pressure, but where it is desired to use emery wheels it is better to roughly grind the tools to shape on a dry emery wheel or dry stone before hardening. By so doing the tools require but little grinding after hardening, and only slight frictional heating occurs, but not sufficient to draw the temper in any way, and thus their cutting efficiency is not impaired. When the tools are ground on a wet emery wheel and undue pressure is applied, the heat generated by the great friction between the tool and the emery wheel causes the steel to become hot, and water playing on the steel while in this heated condition tends to produce cracking. *(To be concluded.)*

The results of the German high speed traction experiments thus far conducted have justified the following conclusions:

1. Permanent way, constructed in accordance with the standard specifications for first-class main lines of the German Government railways, is sufficient for electric trains running at a speed of 125 miles an hour, but the radius of any curve should not be less than 660 ft.

2. The collector used in the Zossen experiments is well adapted for conveying electric energy at high tension and at high speeds from fixed conductors to cars.

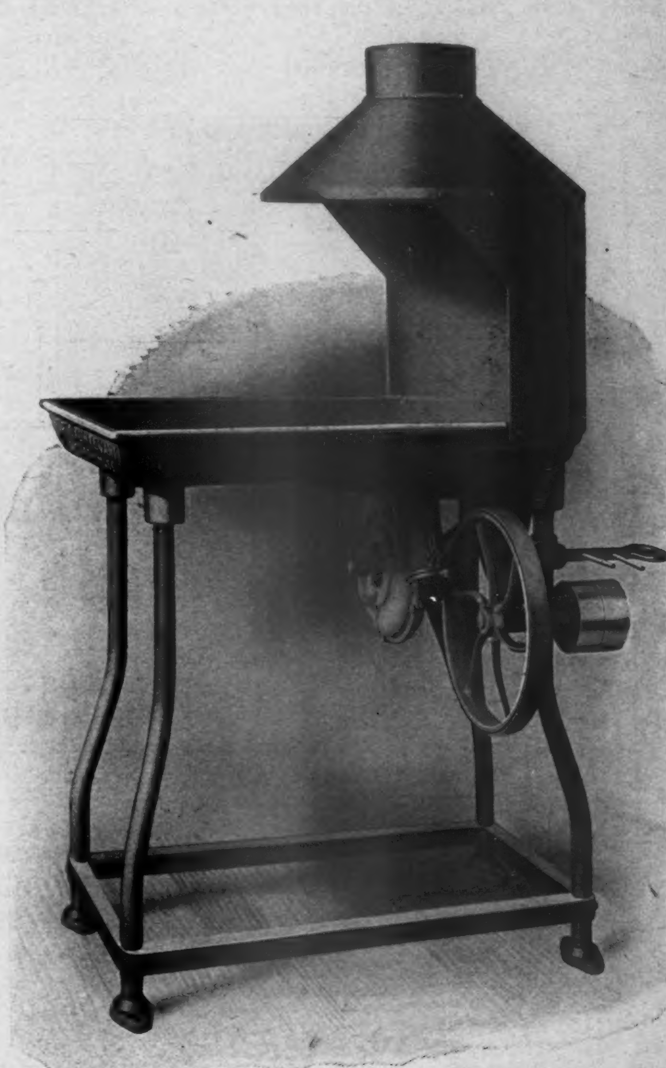
3. The construction of the fixed conductor employed in the German high speed trials has been proven equal to the service.

4. The Zossen trials have demonstrated that high tension current can be used direct without the intervention of transformers.—*Alexander Siemens, International Engineering Congress.*

STURTEVANT PORTABLE FORGES.

The portable forges built by these manufacturers have stood the test of years of service all over the world and now the list of sizes has grown to 31. Not only has the number of sizes increased, but the designs have been perfected in every detail in order to improve their service under the most exacting conditions. The sheet metal work is of heavy steel plate; the running gear is heavy, strong and easy of operation. The tuyeres, are made specially strong to resist the action of the fire and the fire pan is of two metal plates, with asbestos between them to prevent the heat from cracking the main pan or affecting the running gear. The blowers used are of the well-known Sturtevant pressure type, with babbited journal boxes, which have been re-designed to give increased capacity.

These forges are made in seven distinct types, being classi-



STURTEVANT PORTABLE FORGE.

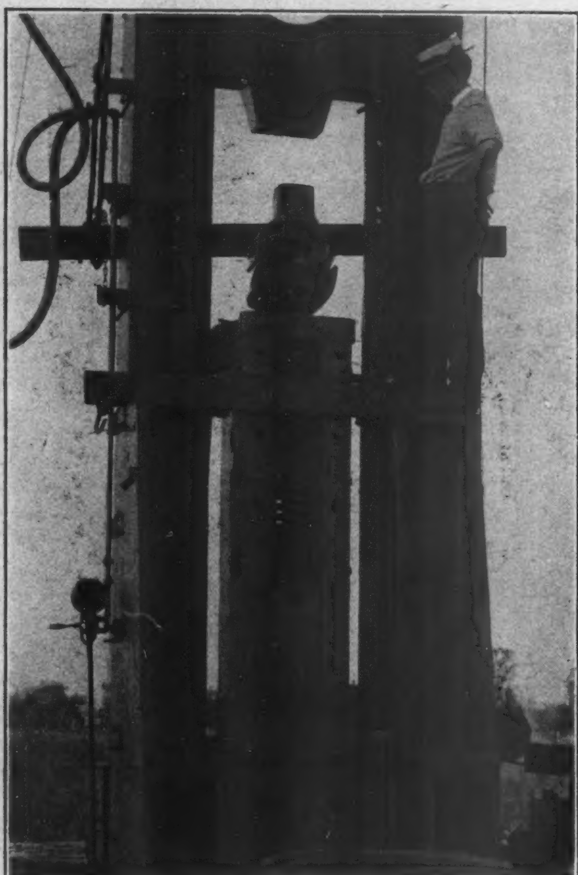
fied with respect to their capacity and the purpose for which they are to be used. The forge selected for illustration is of the C type, fitted with a blower driven by pulley put on the forge, which is belt-connected to the line shaft or other drive. The C forges are made in four sizes, fitted with a tight or loose pulley, by which a continuous blast may be provided, which is easily regulated by a blast grate underneath the fire pan. The Sturtevant portable forges are adapted for the light work of jewelers and the heaviest work for which portable equipment is used. They are manufactured by the B. F. Sturtevant Company of Hyde Park, Mass., who are prepared to furnish complete forge equipment, including portable and stationary forges, blowers and hand blowers for producing the blast; exhaust fans for the removal or smoke, heating systems and other similar equipment. Further information concerning these forges may be had from the manufacturers.

REMARKABLE TEST OF SPRING DRAFT GEAR.

The Farlow draft gear was illustrated on page 365 of the September issue of this journal. A twin spring arrangement was shown. Records of a remarkable test of a single spring gear, of the same make, upon the M. C. B. drop testing machine at Purdue University, September 12, 1904, have been received, and they admirably support the claims of those who pin their faith to spring gears. From the official report signed by Professor W. F. M. Goss, interesting facts are taken.

The first six blows were at 5, 7, 10, 15, 20 and 25 ft., respectively. Then followed 5 blows at 34 ft., the full height of the machine. The next day two more blows were given at 34 ft.

The second blow, at 7 ft., brought the horn of the coupler in contact with the end sill. Blows from 10 and 15 ft., respectively, were successfully withstood without any apparent effect. Slight bending of the angle plate occurred after a blow at 20 ft. A blow at 25 ft. resulted in a slight bending of the links. After this 7 blows at 34 ft. were delivered, the



FARLOW DRAFT GEAR AFTER THE TEST.

gear being examined after each blow. Under this very severe treatment there was a gradual increase in the distortion of the metal parts, and a yielding of the timber work supporting them, but the gear was entirely operative at the conclusion of the test. The photograph reproduced in the accompanying engraving represents the condition of the gear at the *end of the test.*

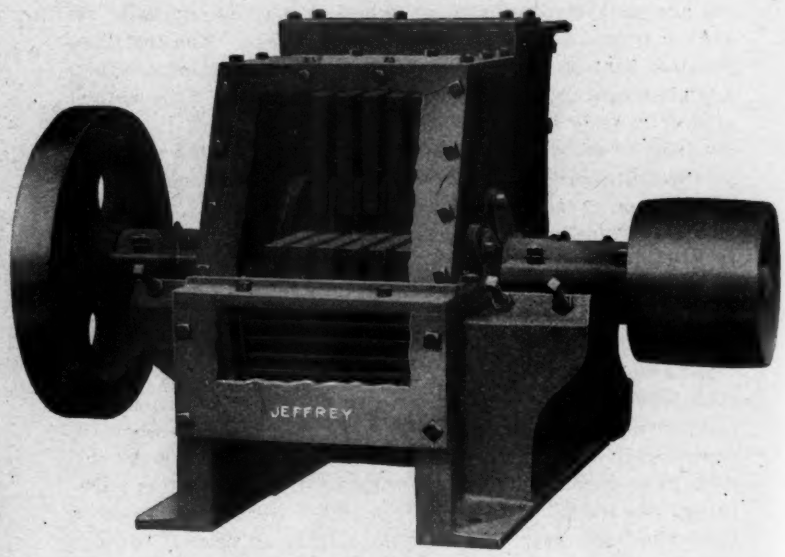
Professor Hatt made an effort to determine the pressure equivalent of a blow of the 1,640-lb. tup, falling from a height of 34 ft. Two copper plugs 2 ins. in diameter and 18 ins. high were placed on the squared end of the upper coupler. The blow of the hammer compressed these blocks 0.282 in. each. A similar block was placed in the static Riehle testing machine of the laboratory, and it was found that a load of 176,000 lbs. was required to produce a similar effect of compression. If these two tests may be directly compared on the basis of equal compression of copper, the force due to the blow of the drop testing machine on the Farlow draft gear is twice 176,000, or 352,000 lbs. It is not claimed that this method is in the slightest degree scientific, but it may be accepted as an approximate measure.

The wooden draft arms when examined by the writer were undamaged. This may suggest to railroad men the possibility that wooden draft arms need not be abandoned because of the liability of the old type of draft gear to be destroyed. These draft arms were not even damaged at the ends next to the coupler. After this punishment this test gear was taken apart in 8 minutes by men who were not accustomed to the work and who did not know they were being timed.

This is certainly a remarkable test, illustrating even unexpected possibilities in spring gears. Further information concerning this test may be had from Mr. M. A. Garrett, vice-president of the Farlow Draft Gear Company, Monadnock Block, Chicago.

JEFFREY HAMMER PULVERIZER.

This type of pulverizer has recently been taken up by the Jeffrey Manufacturing Company, of Columbus, Ohio. The illustration shows the interior or crushing parts. It is designed for crushing and pulverizing a large variety of material, including coal, and is designed with a special view of simplicity. Its special features are its simple beater hammer, its V-shaped screening surface, simple adjustment of the beater arms to accommodate wear, the substantial and adjustable dust proof pillow blocks and large capacity hopper, which permits material to be partly crushed while in suspension.



THE JEFFREY HAMMER PULVERIZER.

By taking out the rear plate and the side hand hole plates the beater arms may be changed and the screening surface renewed. The latter is made up in sections, so that the change from one size to another is quickly made. Its capacity ranges from 50 to 100 tons of coal per hour, dependent upon the degree of fineness. The machine is in extensive use and has passed the experimental stage. The Jeffrey Manufacturing Company offers to make crushing tests, showing the capability of the machine, for those interested. Further information may be obtained from the manufacturers.

A NEW FAN WHEEL FOR MECHANICAL DRAFT.

Because of difficulties occurring in induced draft work, which are not met in other uses of fans, the builders have found it necessary to prepare special designs. These have usually employed two or three spiders, except in the very small sizes. Fans for ordinary service have usually had a bearing on each side, making the distance between the bearings comparatively short, with no tendency toward deflection to the shaft, but when fans must handle hot gases the bearings must

gress.

ing these forges may be had from the manufacturers.

be removed from the gases in order to avoid heating them. This necessitates overhanging wheels, or placing one bearing outside of the inlet chamber built on to the side of the fan. The American Blower Company has devoted special attention to the development of details which will overcome the difficulties of the deflection of the shaft and the effect of the heat upon the housing in work of this character. Fig. 1 shows their latest construction, which is giving good results in service. It has a spider of I beams in order to secure maximum strength. In addition to this, every plate is braced with braces from the outer rim to the center to overcome tenden-

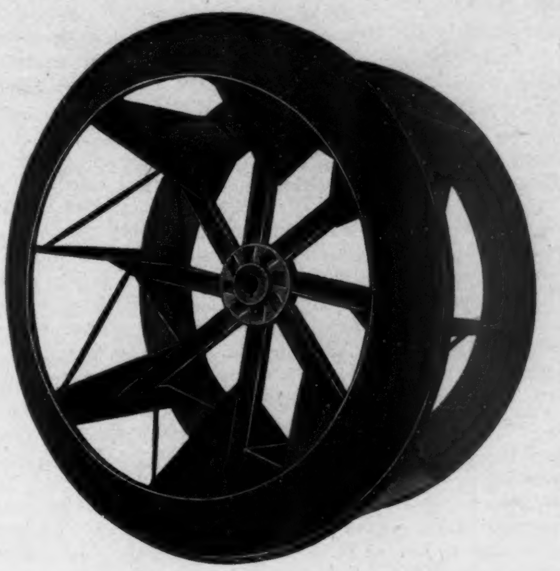


FIG. 1.

cies to twist. In the side of the fan housing a deep cone is placed. The inner bearing is jacketed and carried on a special arm of cantilever construction; this is placed at the apex of the cone, and the distance from the apex to the end of the projecting shaft seldom exceeds 12 ins. A fan wheel mounted on a shaft with a direct-coupled engine, constructed in this way, is shown in Fig. 2. The extension of the base of the engine, as shown, is not always used. In some cases an I

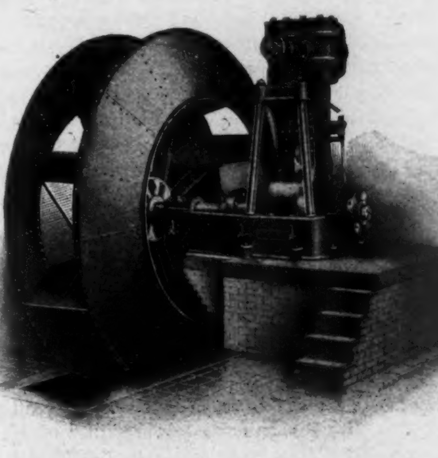


FIG. 2.

beam grillage is built into the brick foundation, the engine being set on top of the outer ends of these beams, and anchored down, which makes practically a complete unit of the entire outfit. Two large units represented by Fig. 2 have been furnished the Wilkesbarre & Wyoming Construction Company of Wilkesbarre, Pa. These wheels are fixed in a three-quarter steel plate housing; the wheels being 11 ins. in diameter and being driven by 12 x 10-in. vertical engine. They will furnish induced draft in the power house of that company.

PERSONALS.

Mr. J. I. Cunningham has been appointed master mechanic of the Pennsylvania Railroad at Columbus, Pa.

Mr. F. J. Pease has been appointed general foreman of the Lake Erie & Western Railway at Lima, Ohio.

Mr. C. H. Hinsdale has been appointed general foreman of the shops and roundhouse of the Pittsburg & Lake Erie Railroad at McKees' Rocks, Pa.

Mr. J. T. Flavin has been appointed assistant master mechanic of the Indiana, Illinois & Iowa Railroad, with headquarters at Kankakee, Ill.

Mr. C. H. Welch has been appointed master mechanic of the Midland Valley Railroad, with headquarters at Fort Smith, Ark.

Mr. A. W. Horsey has been promoted from the position of chief draughtsman to that of mechanical engineer of the Canadian Pacific Railway, with office in Montreal.

Mr. T. H. Goodnow has been appointed general foreman of the car department of the Lake Shore & Michigan Southern Railway at Air Line Junction, Ohio.

Mr. George Thompson has been appointed general foreman of the car department of the Indiana, Illinois & Iowa Railroad, at Kankakee, Ill.

Mr. I. S. Downing has been appointed master car builder of the Lake Shore & Michigan Southern Railway at Englewood, Ill., to succeed Mr. L. G. Parish.

Mr. Joseph Chidley has been appointed assistant master mechanic of the Lake Shore & Michigan Southern Railway at Elkhart, Ind, to succeed Mr. Peter Maher, resigned.

Mr. D. H. Deeter has been appointed master mechanic at the Reading locomotive shops of the Philadelphia & Reading Railroad to succeed Mr. R. Atkinson, resigned.

Mr. H. S. Hunter has been appointed master mechanic of the New York & Philadelphia division of the Philadelphia & Reading Railroad to succeed Mr. D. H. Deeter, promoted.

Mr. L. L. Collier has been appointed master mechanic of the Newton & Northwestern Railroad, with headquarters at Boone, Iowa.

Mr. John Mailer, heretofore master mechanic of the Minnesota & Northern Wisconsin, has been appointed master mechanic of the Fort Smith & Western, with headquarters at Fort Smith, Ark., to succeed Mr. K. P. Alexander, resigned.

Mr. J. A. McRae has been appointed mechanical engineer of the Boston & Albany Railroad with headquarters in Boston, Mass., reporting to Mr. F. M. Whyte, general mechanical engineer of the New York Central lines.

Mr. W. S. Clarkson has been appointed general master mechanic on the Northern Pacific Railway, with office at Livingston, Mont., and will have charge of the Montana division, including the shops at Livingston.

Walter H. Barnes died at his home in Brookline, Mass., November 14, at the age of 70. He was for many years general manager of the Boston & Albany Railroad, and one of the best-known railroad men in New England.

Mr. George D. Brooke, formerly superintendent of motive power of the St. Paul & Duluth, and afterward of the Iowa Central, has been appointed superintendent of motive power of the Panama Canal Commission.

Mr. R. M. Crosby has resigned as master mechanic of the Chicago, Great Western Railway at Oelwein, Iowa, to accept an appointment as shop superintendent on the Northern Pacific Railway at South Tacoma.

Mr. F. F. Gaines, recently resigned as master mechanic of the Lehigh Valley at Wilkesbarre, Pa., has been appointed mechanical engineer of the Philadelphia & Reading, with headquarters at Reading, Pa.

Mr. Grant Hall has been appointed assistant superintendent of motive power of the Western lines of the Canadian Pacific Railway, with headquarters at Winnipeg, Manitoba. He is transferred from a similar position on the Eastern lines.

Mr. Peter Maher has resigned as master mechanic of the Lake Shore & Michigan Southern Railway to accept the position of superintendent of motive power of the Toledo, St. Louis and Western Railroad, with headquarters at Frankfort, Ind.

Mr. R. H. Gilmour, superintendent of the Brooks Works of the American Locomotive Company, died suddenly in Schenectady, October 26, where he was attending a meeting of the works managers of the company.

Mr. W. H. V. Rosing has resigned as assistant superintendent of motive power of the Illinois Central to become mechanical engineer of the Missouri Pacific Railway, with headquarters at St. Louis, Mo.

Mr. William Moir has been appointed general master mechanic on the Northern Pacific Railway, with office at Tacoma, and will have charge of the Rocky Mountain, Idaho, Pacific and Seattle divisions, not including the shops at South Tacoma.

Mr. F. T. Hyndman has resigned as superintendent of motive power of the Buffalo, Rochester & Pittsburg, to become general master mechanic of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., succeeding Mr. F. B. Smith.

Mr. A. W. Wheatley has been appointed general master mechanic on the Northern Pacific Railway, with office at St. Paul, Minn., and will have charge of the St. Paul, Minn., Lake Superior, Dak., and Yellowstone division, not including the shops at Como and Brainerd.

Mr. F. M. Gilbert has been appointed mechanical engineer of the New York Central & Hudson River Railroad with headquarters in the Grand Central Station, New York, to succeed Mr. F. M. Whyte, recently appointed general mechanical engineer of the New York Central lines. Mr. Gilbert has served as chief draftsman for the past four years.

C. F. Thomas, who died October 25 at Albuquerque, New Mex., was an exceptionally bright and able mechanical officer, who will be sadly missed by many friends. His death is a loss to the railroads, because such men are greatly needed to cope with the problems of the present. His leading characteristics were unselfishness and integrity. He did not count the cost of efforts in behalf of others. He entered the service of the Pennsylvania Railroad in 1875 as an apprentice at Renovo. After serving his apprenticeship he went to the Mobile & Montgomery. After that he was connected successively with the Louisville & Nashville, the Chesapeake & Ohio, the East Tennessee, Virginia & Georgia, the Richmond & Danville, the Southern, and in 1902 he became general inspector of the Richmond Works of the American Locomotive Company. Mr. Thomas was a member of the Master Mechanics' and the Master Car Builders' associations, and served these organizations actively and effectively. He was studious and enterprising, and gave a great deal of thought to improvement in shop methods and devices. By his personal qualities he endeared himself to many friends.

BOOKS.

Some After Dinner Speeches. With a Few Anecdotes of Famous Men. Published by the Bookkeeper Publishing Company, 61 West Fort street, Detroit, Mich. Price $1.00.

This little book of 220 pages will be found convenient by those who are not apt entertainers and are occasionally called upon to respond to a toast. It contains a number of speeches by well known public men and some excellent stories.

American Railway Master Mechanics' Association. Proceedings of the Thirty-seventh annual convention held at Saratoga, N. Y., June, 1904. Edited by the secretary, Mr. J. W. Taylor, Rookery Building, Chicago.

In addition to the rules, and standards this volume contains a number of valuable individual papers and committee reports. The secretary is to be complimented upon the short time required to get out this report, which covers over 550 pages.

Proceedings of the Eleventh Annual Convention of the Air Brake Association. Held at Buffalo, May, 1904. Edited by the Secretary, F. M. Nellis, 26 Cortlandt street, New York.

This volume of 282 pages contains the reports, proceedings and discussions of this organization, which is devoting its efforts to the following object: "To obtain a higher efficiency in air brake service." It is an important volume to those who have to do with the air brake. This volume contains, among others, exceedingly important papers concerning the advisability of increasing brake pressures and the friction of brake shoes, both of which are vital subjects in the present air brake situation.

Railway Storekeepers' Association. Proceeding of the first annual meeting.

This association met in Chicago last May and the record of proceedings indicates a very successful convention. The book of 209 pages opens with an elaborate list of subjects of papers which is followed by the discussions which cannot fail to bring very valuable results to the railroads because of improved methods of handling supplies. Among the illustrations are engravings of the store department supply cars used on the Lake Shore & Michigan Southern Railway. This association has been most successfully launched and promises to be an important source of improvement of methods of handling storehouse material. Managers and motive power officials should read the discussions carefully. Mr. J. P. Murphy, general storekeeper of the Lake Shore & Michigan Southern Railway, is president of the association.

Report of the United States Naval "Liquid Fuel" Board. Government Printing Office, Washington, D. C.

This elaborate report of 450 pages records the tests of the "Hohenstein Boiler" and the "Liquid Fuel" Boards, constituting the most authentic and exhaustive information collected by the Navy Department under the direction of Rear Admiral G. W. Melville. It is undoubtedly the best work ever written on this subject and contains information and studies in oil burning which are of greaat value in the use of this fuel for other than naval purposes. The classification of burners occupies 26 pages. Those who are burning oil in locomotive service should carefully study this remarkable report. Presumably copies may be obtained through members of Congress.

Poor's Manual of Railroads, 1904. Thirty-seventh Annual Number. Published by Poor's Railroad Manual Company, 68 William street, New York. Price $10.00.

This volume, just from the press, contains 1,600 pages of tables and summaries of railroad statistics. It presents detailed statements of the operations and condition of every railroad company in the United States, Canada and the leading lines of Mexico. It also contains 24 colored plates, state and group maps and 44 maps of leading railroads. According to the statistics the railroads completed up to the first of the current year aggregate 207,603.53 miles, with 717.54 miles completed since the close of their fiscal years. Poor's Manual represents 203,052 miles of line in its statistics, indicating the value of the figures as representing the railroad situation of the country. The tables are very complete and are arranged to show the progress of freight and passenger traffic for 13 years, the statement of railroad construction for four years and other statistics concerning periods sufficiently long to permit of making intelligent comparisons of progress. This book needs no introduction to our readers. It is sufficient to say that the present volume maintains, in every way, the reputation of the previous ones.

Master Car Builders Association. Proceedings of the Thirty-eighth annual convention held at Saratoga, N. Y., June, 1904. Edited by the secretary, Mr. J. W. Taylor, Rookery Building, Chicago.

The convention reports and proceedings in connection with the interchange rules and the standards and recommended practice constitute a volume of 584 pages and a large number of folded plates. Considerable credit is due the secretary for its early issue.

American Railway Shop Systems. By Walter G. Berg, chief engineer Lehigh Valley Railroad, Pa. 198 pages, illustrated. Published by *The Railroad Gazette*, 83 Fulton street, New York, 1904. Price $2.

Mr. Berg is well known as a painstaking writer, who approaches his subjects in a logical, systematic way. In this work he has assembled plans and information concerning all of the important railroad shops built in this country during the past 14 years, and these are classified and studied in order to draw conclusions as to tendencies of design. Instead of presenting original ideas, it is a record of practice as shown in existing structures. The author has with great care presented in a book of moderate size all the railroad shops which are worth considering by railroad officials who contemplate building new shop plants. There is no other book on railroad shops; and readers who are called upon to design or construct new shops will find this work invaluable. The author discusses longitudinal vs. cross erecting shops--but from the standpoint of an engineer rather than a shop manager. His chapters include: Classification and general layout, general repair shops, locomotive repair shops, passenger and freight car shops, store houses, power plant and machinery, structural work, and presents a very useful bibliography of descriptions of shops from the technical press. Thirty-six shop plans are shown, and the most interesting are illustrated in half-tone engravings and cross sectional drawings. The book is the work of an engineer rather than an expert who knows the merits of various shop arrangements because he is or has been "up against" the problem of keeping down the cost of repairs, but it is the best record of existing practice and, in fact, the only convenient record available. Mr. Berg has put railroad officials under heavy obligations to him for this admirable book. No new railroad shop should be built without carefully consulting and studying this work. It should be in every railroad drafting room, every motive power and manager's office, and the technical schools giving special attention to railroad subjects should use it as a text book.

Locomotive Operation: A Technical and Practical Analysis. By George R. Henderson, Member A. S. M. E. Cloth, 6 by 9 ins.; 536 pages, 142 illustrations and 5 folding plates. Published by The Railway Age, Monadnock Block, Chicago, Ill. Price, $3.50.

This book would make a high reputation for the author, if he had not earned it previously, as a railroad officer. His object was to study the locomotive and what it will do, how it does it and what it costs in fuel, placing the whole subject before the reader through an investigation of the results accomplished, which are presented in detail. The work is a book of reference on the locomotive without specifically treating of the details of design. It shows the relation between theory and practice as measured by practical results. It is a scientific study by a man who has been responsible for operation as well as design and construction. Inertia, action of steam, resistance, slipping and braking preface the chapters on hauling power and economical speeds. Water and fuel consumption follow. The author reproduces a number of discussions of important factors from other authorities, and discusses the laws governing the subjects. The book is rich in original diagrams graphically representing the conclusions of the text, which are exceedingly convenient for consultation in solving problems in locomotive performance. The most important feature is the study of economical hauling of trains, and in presenting this subject Mr. Henderson places the railroad officials of the world under obligations to him, as he does in the articles on the same subject now appearing in the pages of this journal. The book is original and covers ground never before attempted in any work on the locomotive. The student will find the mathematics worked out in detail, while the manager and motive-power officer will use the diagrams for direct application to his problems. Aside from its interest to the student, operating official and motive-power superintendent, Mr. Henderson's book must necessarily exert a much needed influence tending in the direction of a clearer understanding of the locomotive in motion. In this its effect will be timely in connection with the promising tendency of the time toward more intelligent railroad operation in which the locomotive is the leading feature. The book is not disappointing in any respect.

NEW CATALOGUES.

In writing for these catalogues please mention this paper.

PLANERS, HIGH SPEED.—Catalogue No. 1 from the Chandler Planer Company, Ayer, Mass.

LATHES.—Catalogue B from the Draper Machine Tool Company, Worcester, Mass.

RADIAL DRILLS.—Set of leaflets from the Fosdick Machine Tool Company, Cincinnati, O.

DISC GRINDERS.—Pamphlet from the Ransom Manufacturing Company, Oshkosh, Wis.

WOODWORKING MACHINERY.—Catalogue A from the "Oliver" Machinery Company, Grand Rapids, Mich.

UPRIGHT DRILLS.—Catalogue No. 61, 2nd edition, from the W. F. & John Barnes Company, Rockford, Ill.

LATHES.—Catalogue No. 23 from the Bradford Machine Tool Company, Cincinnati, O.

WOOD WORKING MACHINERY.—Catalogue 194 from the Defiance Machine Works, Defiance, Ohio.

DRILLS, LATHES, WATER TOOL GRINDER.—B. F. Barnes Company, Rockford, Ill.

BOLT AND NUT MACHINERY.—The National Machinery Company, Tiffin, Ohio.

REAMERS, UNIVERSAL ADJUSTABLE.—F. B. McCrosky Manufacturing Company, Meadville, Pa.

PUNCHES AND SHEARS.—Catalogue D from the New Doty Manufacturing Company, Janesville, Wis.

BORING AND TURNING MILLS, A TREATISE ON.—Catalogue D-11 from the Bullard Machine Tool Company, Bridgeport, Conn.

HORIZONTAL BORING MACHINES.—Catalogue and treatise No. 3 from the Binsse Machine Company, Newark, N. J.

TAPS, DIES, SCREW PLATES, ETC.—Catalogue and price list from the S. W. Card Manufacturing Company, Mansfield, Mass.

WATERPROOF LEATHER BELT.—Circulars issued by the Graton & Knight Manufacturing Company, Worcester, Mass.

VERTICAL BORING AND TURNING MILL, 64-INCH.—Bulletin just issued by the Gisholt Machine Company, Madison, Wis.

CHUCKS.—Catalogue No. 7 describing the Sweetland chuck made by the Hoggson & Pettis Manufacturing Company, New Haven, Conn.

BORING TOOLS, CHICAGO ADJUSTABLE.—Pamphlet issued by C. A. Nordquist, 39 W. Randolph street, Chicago, Ill.

WOOD WORKING MACHINERY.—A loose leaf catalogue from the S. A. Woods Machine Company, Boston, Mass., describing tools applicable to railroad shop work.

BORING AND TURNING MILL.—Pamphlet from the Colburn Machine Tool Company, Franklin, Pa., describing their 72 in. widened pattern vertical mill.

GRINDING MACHINES.—Leaflets describing the universal and plain machines made by the Landis Tool Company, Waynesboro, Pa.

MACHINE TOOLS.—Catalogue T from the Hilles & Jones Company, Wilmington, Del., describing tools for working plates, bars and structural shapes.

MACHINE TOOLS.—Bulletins 530 to 538 inclusive from The C. E. Sutton Company, Toledo, Ohio, describing their punches and shears, forging machines, milling machines and lathes.

MILLING MACHINE IN COMBINATION WITH PLANER.—Catalogue from the Adams Company, Dubuque, Iowa.

EMERY AND CORUNDUM WHEELS.—Catalogue and price list from the Hampden Corundum Wheel Company, Brightwood, Springfield, Mass.

INDEX CENTER FOR SHAPER.—Circular from the Stockbridge Machine Company, Worcester, Mass., describing their No. 2 Index Center.

COBURN TROLLEY TRACK.—The round trough track for shop and warehouse trolleys, with trolleys and supports is described in a pamphlet received from the Coburn Trolley Track Manufacturing Company, Holyoke, Mass.

PNEUMATIC TOOLS.—The Chicago Penumatic Tool Company have just issued a very attractive catalogue of 122 pages which describes the various tools made by them. It also contains some interesting information concerning the comparative cost of hand and hammer riveting.

"JACKOHOL."—A leaflet from the Watson-Stillman Company, 204 East 43d street, New York, describing this improved liquid for hydraulic jacks, which is a non-corrosive and lubricating compound, will not thicken in freezing weather, nor cause the valves to stick or clog, and which can be produced at about one-half the cost of the standard formula.

GAS PRODUCERS.—"Catalogue B" of the Wile Power Gas Company of Rochester, N. Y., describes gas producers for making gas from bituminous or anthracite coal. The gas is suitable for heating furnaces as well as for running gas engines. This company also presents information as to the uses and cost of producing gas, in their "Catalogue A."

HYDRAULIC TURBINES AND GOVERNORS.—Publication No. 112 issued by the Department of Publicity of the Allis-Chalmers Company, Milwaukee, Wis. It describes the Escher Wyss & Company turbines, the Francis type turbine, the Allis-Chalmers high-pressure impulse turbine and the hydraulic and universal governor made by this company.

RUSSO-JAPANESE WAR ATLAS.—The Continuous Rail Joint Company of America, Newark, N. J., are distributing an excellent atlas as a souvenir of the St. Louis World's Fair. It includes Russia-in-Europe, Russia-in-Asia, Japan, Korea, Manchuria and China. It is just the thing wanted in order to understand the reports of the far eastern conflict. The atlas is by Rand, McNally & Company.

SHADE ROLLERS AND ACCESSORIES.—A new catalogue of 30 pages has been issued by the Stewart-Hartshorn Company, E. Newark, N. J. The product of these well-known manufacturers is illustrated and described with prices and dimensions. Special rollers for railroad cars, tin rollers, self-acting wood rollers, new bottom clips, shade pulls, guides, clasps and brackets are shown in detail. This company has devoted many years to the development of shade rollers and their methods of manufacture insure the production of rollers of the highest standard.

GISHOLT BORING & TURNING MILLS.—The general line of Gisholt vertical and horizontal mills is described in a beautifully illustrated catalogue issued by the Gisholt Machine Company of Madison, Wis. The machines are described, but without detailed dimensions. Sufficient information is given to indicate the size of work for which each machine is adapted, and the machines themselves are illustrated by means of excellent engravings. The pamphlet also includes an illustrated description of turret lathes and of the Gisholt tool grinder. These builders lay special stress upon strength, simplicity, convenience, and the production of rapid and accurate work.

DRY KILNS FOR TIMBER PRODUCTS.—A handsome 78-page catalogue of dry kilns and accessories has been issued by the American Blower Company of Detroit. It is really a brief treatise on kiln drying and illustrates the system and the apparatus manufactured and employed by this company. It is handsomely illustrated, treats of the theory of lumber drying and explains the "A. B. C." moist air dry kiln, its construction and operation. Heaters, fans, apartment kilns and dry kiln appurtenances are illustrated in detail and a number of kilns are shown from photographs of working plants. The pamphlet also contains a large number of favorable reports from users.

NOTES.

ELECTRIC CONTROLLER & SUPPLY COMPANY.—This company of Cleveland, Ohio, announce that they have been awarded the first prize for their exhibit at the St. Louis Exposition. This consists of their various controllers, magnetic friction and stop brakes, cushion type solenoids, electric lifting magnets, etc.

NUT LOCKS AT THE EXPOSITION.—In the transportation exhibits the nut locks on a number of the cars attracted the attention of the writer. Those on the cars exhibited by the Pressed Steel Car Company and also other cars were manufactured by the Bartley Nut and Bolt Fastener Company of Pittsburgh.

PNEUMATIC DRILLS.—The United States Government has just purchased from the Rand Drill Company 27 Imperial pneumatic hammers and drills. These are to be used in connection with the Manila harbor improvements.

CHICAGO PNEUMATIC TOOL COMPANY.—This company has been awarded two gold medals or the highest awards covering their exhibit at the Louisiana Purchase Exposition. They have secured the highest awards at all exhibitions both foreign and domestic since there first exhibit, which was made at the Cotton State Exposition at Atlanta in 1895. Mr. J. W. Duntley, president of this company sailed for Europe on November 8 on a four weeks' business trip.

NORTHERN ELECTRIC GENERATORS.—The new isolated plant installed in the 23rd Regiment Armory, Brooklyn, N. Y., will contain two 75 K. W. Northern generators direct connected to Harrisburg engines operating at 275 r.p.m. They also have a 35 K. W., 600 r.p.m. Northern generator belted to a Nash gas engine

PRIZES TO THE WESTINGHOUSE COMPANIES.—Twelve grand prizes, 8 gold, 4 silver medals and one bronze medal were awarded to the Westinghouse Companies for their elaborate and instructive exhibits at the St. Louis Exposition. This is probably the longest and most comprehensive list of high honors ever received by associated interests at any world's fair. In addition to these prizes a special award was granted for the best, most complete and most attractive installation in the department of machinery.

FALLS HOLLOW STAY BOLTS.—An order has just been received from Japan for 28,000 lbs. of 1⅛-in., 18,000 lbs. 1¼-in. and 12,000 lbs. of 1⅜-in. Falls hollow round bars 10 ft. long, which is to be made into stay bolts by the Kiushiu Railway. Other railways of Japan and the Japanese Government are also receiving large quantities. The Norwegian State Railway uses this material exclusively for fire boxes of their locomotives, and numerous inquiries are coming from other European roads.

The Standard Roller Bearing Company of Philadelphia announces the purchase of additional land, on the main line of the Pennsylvania, at Girard avenue and Forty-eighth street, Philadelphia, and also a tract adjoining the factory on the west, with a frontage on the railroad. Upon this property a steel casting plant will be erected, also an addition to the foundry and a large addition to the factory for making steel balls. The increase in the business of the company has necessitated the purchase of a large number of tools and other equipment, which will provide increased facilities for meeting the demands from the purchasers. Mr. S. S. Eveland, manager of the company, is in charge of the improvements.

A LARGE HEATER INSTALLATION.—Over twenty-five miles of 1-in. steam pipe is being put into 111 "A B C" heaters in the new Wanamaker building in Philadelphia by the American Blower Company of Detroit, Mich. The heating surface varies from 5,500 to 5,600 ft. in each heater. The installation includes 28 "A B C" fans, the largest being 220 in. high and the smallest 30 in. The completed apparatus will make a 10-car load shipment. Similar apparatus is being supplied by the same company for the Wanamaker building in New York. The American Blower Company has also received a contract for heating apparatus for the shops of the Philadelphia Rapid Transit Company in Philadelphia. The apparatus consists of a heater containing 5,700 ft. of 1-in. pipe and 10-ft. fan with a 7-ft. wheel operated by direct connected motor.

ELECTRIC TRACTION ON LONG ISLAND RAILROAD.—The Westinghouse Electric & Manufacturing Company has sold to the Pennsylvania Railroad double motor equipments for 122 cars, with Westinghouse multiple unit control for these cars and for 61 trailers. These equipments will be used by the Pennsylvania for its Long Island suburban traffic, and will be put into operation next spring. The motors will be of the latest Westinghouse type, with a rating of 200 h.p. each; they will embody the most modern ideas in both electrical and mechanical design, and will possess an extremely liberal overload capacity. The Westinghouse Company has been very successful in the design of railway motors, and in the design of this equipment will undoubtedly maintain its very enviable reputation. The machinery for the Long Island power plant which is now being installed is supplied by the Westinghouse Company, and will include three turbo-generators, each having a capacity of 5,500 kilowatts as a notable part of the plant.